APPLICATION OF SPECTRAL MAPS TO SOIL SURVEY IN THE CALIFORNIA DESERT

Final Report

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FINAL REPORT

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BUREAU OF LAND MANAGEMENT

California Desert District

1695 Spruce Street

Riverside, California 92507

by

L. J. Lund

Principal Investigator

Department of Soil and Environmental Sciences

University of California, Riverside

Riverside, California 92521

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BACKGROUND

Mapping soils according to standards of the National Cooperative Soil Survey depends to a large degree on field investigations to determine the characteristics of soils found in an area and their distribution across the landscape. A soil surveyor should make use of all accessory information relative to the survey area. Traditionally this information has consisted of geological information and maps, topographic data and aerial photography. With the launching of the first LANDSAT satellite in 1971, a new source of data became available, multispectral scanner (MSS) data commonly referred to as Landsat data or imagery.

Visual photointerpretation techniques were applied to Landsat images by Lewis et al. (1975) to delineate soil associations in the Sand Hills region of Nebraksa. They found that soil associations could be delineated at map scales of 1:100,000 to 1:300,000 where relationships between vegetation, topography and soil drainage and soil taxonomic units were known.

Westin and Frazee (1976) also reported on the application of Landsat imagery to soil survey. The advantages of using Landsat data given by Westin and Frazee included: 1) synoptic view of 3.5 million hectares recorded at nearly the same point in time; 2) near-orthographic character of Landsat images; and 3) the availability of MSS data in four wavelength bands. They pointed out that tne low resolution, atmospheric attenuation and fixed wavelength bands may be disadvantages, especially for surveys of high intensity.

Landsat images are not the only products available through the Landsat program. Digital data from which the images are produced can be obtained for each of the four MSS bands. The availability of digital data makes it possible to analyze Landsat scenes or portions of scenes by digital analysis (pattern recognition) techniques.

Weismiller et al. (1977) were among the first to process digital Landsat data to forms that could be used as an aid to soil survey. They developed spectral maps for Chariton County, Missouri. Combining spectral data with topographic data they reported that spectral classification can aid in identifying meaningful divisions of soils.

Spectral maps were developed by Kirschner et al. (1978) for use in the Clinton County, Indiana, survey. The successful application of spectral maps in this county was largely due to the relationships between soil drainage characteristics and mapping units. They concluded that "digital analysis of Landsat multispectral scanner (MSS) data provides a means of accurately delineating and quantifying soil map unit composition." Among the contributions that spectral maps may make to ongoing soil surveys are aid in delineation of map unit boundaries, aid in selecting areas most representative of map units and determination if inclusions exist within mapping units and whether they are similar or contrasting (Kirschner et al., 1978).

Many of the applications of spectral data to soil survey have been made in the midwest where soil drainage classes are closely related to soil mapping units. Drainage (soil moisture) differences are readily detected in the infrared bands (6, 7). The survey presently being conducted in Ford County, Illinois, is using spectral maps developed

from Landsat data (Kiefer et al., 1980). Again mapping units in this county reflect drainage differences to a large degree.

When soils of the semiarid to arid west are considered, soil drainage class is not nearly as important in design of mapping units. Soil textures, particle size classes, and the presence or absence of diagnostic subsurface horizons are more important in establishing taxonomic and map unit criteria. For the successful application of Landsat data to surveys in these areas different relationships between spectral data and soil characteristics need to be established.

DiPaola (1979) in discussing the application of Landsat data to soil survey in Idaho concluded that "Landsat data can be used as a tool for stratifying large areas into smaller units which can be sampled more efficiently in the field." This is especially important where third order surveys are being conducted, as in Idaho, and field time is limited.

Increased mapping rate and improved map quality were cited as advantages of using spectral maps derived from Landsat data as aids to soil survey in the Big Desert Area of Idaho (Lund et al., 1980 a, b). The survey team estimated that the spectral maps resulted in a 10% time savings. Improved map quality resulted from more accurately placed map unit boundaries and improved definition of inclusions. In this survey area, lava flows and rock outcrops are quite prominent. Percentage rock outcrop was important in design of mapping units. The spectral maps were quite effective in identifying rock outcrops. The spectral maps also gave the surveyors clues as to where they should field check and with what intensity. The soil surveyors felt that overall the use of

the spectral maps resulted in a better soil survey, however, quantitative data to support this are not available.

Little work has been done in the desert southwest on the application of Landsat data to soil survey. Some characteristics of these desert areas would indicate that Landsat data could be used with success. These include lack of vegetation which can interfere with soil reflectance, lack of profile differentiation in many of the soils (i.e., uniform with depth) and detailed (1st or 2nd order) soil surveys are not needed.

In order to evaluate whether spectral maps can aid soil survey in the California Desert the study described in this report was initiated. The objective of this project was to develop spectral maps of the Chuckwalla Valley area near Desert Center, California, and determine if spectral classes displayed on the maps can be interpreted for soil survey purposes.

SELECTION OF STUDY AREA AND LANDSAT DATA

The general guideline for the study area was that it include the Chuckwalla Valley which extends from the east side of the Eagle Mountains to south of the McCoy Mountains (Fig. 1). The study area was selected to cover this entire valley and fit to the USGS topographic quadrangle series. It included the six 15' quadrangles (1:62,500) shown on Fig. 2 which cover an area of approximately 966,000 acres.

Topographic quadrangles of the 7.5' series (1:24,000) were not available for the area of interest. As will be discussed later, this was a problem in that the output facilities at the Laboratory for Application of Remote Sensing (LARS) at Purdue were designed for scales of 1:24,000 or multiples thereof. This area did have a wide range of landforms (playas, dunes, fans and mountains) which encompasses the range of features commonly found in the California Desert.

A Landsat scene (5473-16651) from August 4, 1976, was selected as the source of the digital data to be used for this project (Fig. 3). This scene was cloud free and of relatively high quality. These data were purchased from the EROS Data Center and sent to LARS for preprocessing. The entire scene was put in LARSYS format and a grayscale of Channel 5 was printed (Fig. 4). An alphanumeric printout (PICTUREPRINT)* that could be reduced and overlain on the 1:250,000 Salton Sea sheet was produced. By using this printout the lines and columns of the LARSYS formated Landsat scene that generally covered the study area could be identified, lines 1-1387 and columns 1-2392. These data were then geometrically corrected and resampled to result in data that were scaled to 1:24,000 and oriented approximately north. The output of

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*All digital processing was done using the LARS computer facilities and LARSYS software via a telecommunications line from UCR to Purdue. LARSYS data handling and analysis programs will be indicated throughout this report in all capitals (Phillips, 1973).

this correction process had 1443 lines of data and 2212 samples per band (bands 4, 5, 6, 7) per line (Fig. 5).

Grayscales of corrected band 5 data were then produced (PICTUREPRINT) as overlays that could be reduced to 1:62,500. These overlays were used to determine the coordinates of the 15' quadrangles. It became apparent at this time that the corrected data was still slightly skewed. The lines and columns did not align exactly with the quadrangles. This problem remained throughout the study and is found in the final spectral maps. Also because of this skewing it was not possible to work with just the data set covering the six 15' quadrangles. The LARSYS software works with lines and columns and it is very expensive to work with diagonal boundaries. Therefore, a data set was used that extended beyond the study area boundaries. For clarity this larger area will be referred to as the project area and the area corresponding to the six 15' quadrangles is designated as the study area.

DEVELOPMENT OF SPECTRAL CLASS STATISTICS

The analysis process for the data covering the study area consisted of a number of iterations. They will not all be discussed in detail here. The emphasis will be on the overall methodology and output products and not on all the detailed steps.

The Landsat data covering the study area consisted of reflectance data for four wavelength bands, band 4 (.5 to .6 μm), band 5 (.6 to .7 μm), band 6 (.7 to .8 μm) and band 7 (.8 to 1.1 μm). The first step in

processing these data was to identify and group pixels (picture elements or minimum resolution elements of multispectral scanner) that had similar reflectance characteristics. This was accomplished using a clustering algorithm (CLUSTER) in the LARSYS software. This algorithm takes a designated number of data points and divides them into a specified number of classes. Statistical parameters (means and variances) of these classes (clusters) are calculated. Members of one class that would fit better into another class are moved and new statistical parameters are calculated. The algorithm continues to go through this procedure until only a small percentage of individuals changes classes within any one iteration, for example 1.5 or 2%. When this point is reached a statistics deck is produced that contains statistical parameters for each of the classes. These data can then be processed further by combining or deleting classes.

Pixels for which reflectance data were clustered were selected according to two formats for this project. One approach used was to cluster a 1% sample of the project area. The other was to cluster 6% samples of smaller test sites. Each of these is discussed in the following sections.

Clustering of project area

A 1% sample of the pixels representing the project area was selected by using data from every 10th line and every 10th column. A 1% sample was selected because 1) it gave an adequate number of points (> 8000) which on the average would give 500 pixels per class at 16

classes (100 being considered a minimum number needed); 2) it avoided the possibility of consistently using bad data lines (data is collected by MSS in groups of 6, therefore intervals of 2, 3, 6 need to be avoided); and, 3) the cost increases as the sample size increases. These data (8816 samples, each with reflectance values in 4 bands) were clustered into 16 classes using a convergence value of 98.5% (maximum of 1.5% of data points changing classes at the final iteration). The spectral characteristics of each cluster class developed from this process are given in Table 1. For each class the mean reflectance in each band is given and they are summed to obtain the magnitude. The ratio of visable to infrared (VIS/IR) is determined by dividing band 4 + band 5 by band 6 + band 7. Lastly the number of points in each cluster class is given.

Preliminary interpretations of the spectral characteristics of the cluster classes combined with an alphanumeric cluster map that was part of the output led to the following points.

----- The range in magnitude was very large and indicated the presence of low reflecting materials (class 16 - magnitude 94.85) and very high reflecting materials (class 1 - magnitude 295.58). If one compares between scenes (either spacially or temporally) magnitudes can vary because of variations in moisture content of reflecting surfaces, atmospheric conditions and other factors. Thus, the absolute reflectance values may not be directly comparable. However, the range of magnitudes would be more comparable as a result of a more or less uniform shifting up or down of magnitudes of classes within the scene. With this limitation in mind, the

magnitudes of cluster classes developed for Ford County, Illinois, ranged from 71.62 to 161.76 (Kiefer et al., 1980). That area is characterized by poorly drained Mollisols (low reflecting) and lacks high reflecting areas; therefore, the range of magnitudes is somewhat limited. The range of magnitudes for the Big Desert Area in Idaho (Lund et al., 1980) was also less (38.62 to 178.94) than that found for this project. The Big Desert Area is characterized by extensive areas of nonvegetated, rough lava which gave very low reflectance values. The large range of magnitudes in the present study indicated that greatly differing materials were present in the Chuckwalla Valley area. From the cluster map it appeared that points in the lightest classes (high reflecting) were located in the valley areas, especially the Chuckwalla Valley. Points in the darkest classes were located in the mountains and on the fans around the mountains.

The visable/infrared ratio (VIS/IR) indicated that vegetation was not making a measurable contribution to the reflectance values. As the vegetative cover increases, the VIS/IR ratio is expected to decrease. In Ford County, Illinois, ratios of 0.4 to 1.0 were found for alfalfa, pasture, corn, soybeans, depending on the percentage cover. In Idaho where grasses and sagebrush were abundant, ratios were in the range of 0.3 to 1.2. The darkest lava classes had ratios around 1.5. The ratios of the cluster classes developed for the present project area ranged from 1.40 to 1.75 indicating that vegetation was not an important factor in this area. The scene was taken in late summer when the vegetative

cover is minimal for an already sparsely vegetated landscape. Thus a minimal contribution from the vegetation was not unexpected.

Clustering of test sites

A grid system was overlain on the project area to define square plots (80 lines by 100 columns) containing 8000 pixels (9200 acres). Fifteen plots were randomly selected to be used as test sites. The locations of these test sites are shown in Fig. 6.

For each test site a 6% sample (every 4th line and 4th column) was clustered into eight classes with a 98% convergence. These parameters were selected after testing a number of combinations.

The variation in reflectance characteristics within an individual test site was generally much less than for the project area as a whole. This was reasonable in that it was unlikely that the entire range of soils, landforms, surface covers, etc. found in the project area (1567 square miles) would be found within a restricted area of 14.4 square miles (test site size). The spectral characteristics of the cluster classes developed for each test site are given in Appendix 1 and are summarized in Fig. 7.

Interpretations made from these cluster data were as follows:

----- Considering the test sites collectively, the range in magnitude exceeded that found by clustering the 1% sample of the project area. For test site 53 a low of 88.73 was found and for test site 32 the high was 306.59. This indicated that the test sites as a group spanned the values found in the 1% sample. As such

the features present in the larger area should be adequately represented in the 15 test sites (i.e. the selection of test sites resulted in a representative sample).

----- In individual test sites there were cases of the ratios, similarly to magnitudes, being lower and higher than for the project area as a whole. These extremes were dampened out by the broader spectrum of values included in the 1% sample. No greatly different ratios were found, however.

----- The range of magnitudes within individual test sites was generally limited with site 91 representing the smallest range (187.45 to 240.37). The test sites dominated by mountains (16, 55, 94, 95) had the lower values. Test site 20 which is dominated by sand dune areas only had high magnitudes (> 250). Test site 55 which has landforms ranging from dunes to mountains has the widest range of magnitudes for the individual sites (91.53 to 269.24). The variance for the brightest class in test site 55 was very high indicating that even though the class mean is only 269.24, individual pixels within the class likely exceeded 300. On a small scale, test site 55 comes the closest of any of the test sites to representing the complete range of features found in the project area.

Selection of statistics for classification of test sites

Because of the greatly differing spectral characteristics of cluster classes among test sites, a decision had to be made as to which

cluster data should be used for preliminary classification of test sites, the test site data or the project area data. If detailed classification maps are needed of relatively small land areas then the cluster data for each individual test site should be used to classify all the points within that site. However, the objective of this study was to investigate the application of spectral data over large areas. Classification maps of test sites using cluster statistics developed from test site data would only be of local importance and difficult to relate to the larger area. Therefore, it was decided that the cluster statistics to be used in classification of the test sites would be from the entire project area. The test site cluster data would be used as a check to see that the important local features within test sites were not lost in the classification.

The 1% sample of the project area was clustered into 16 classes (Table 1). The data for each of these classes (means and variances) were evaluated to determine if the classes resulting from the clustering algorithm were statistically separable. This was accomplished using transformed divergence calculations (SEPARBILITY) (Swain, 1978). Using a transformed divergence values of 1500 as the minimum value indicating separable classes (for divergences > 1500 correct classification can be expected in > 85% of cases; Boyd and Lindenlaub, 1979) classes 5 & 6, 6 & 7, 7 & 8, 8 & 9, and 9 & 10 (Table 1) were not separable. Classes 8 & 9 were merged (MERGESTATISTICS) to increase the separability as much as possible while maintaining as many individual classes as possible. Spectral characteristics of the resulting fifteen classes are given in Table 2. Classes 5 & 6 and 6 & 7 (Table 2) still had divergences less

than 1500 (1448 and 1422, respectively); however, further merging was not done at this point.

CLASSIFICATION OF TEST SITES

All fifteen test sites were classified using the 15 classes given in Table 2. The classification algorithm used in this step (CLASSIFY-POINTS) was a minimum distance classifier. A decision was made to use this algorithm rather than a maximum likelihood classifier because of the anticipated application of the output product and cost. Application of spectral maps to a low intensity survey which was our intention does not require the potentially greater accuracy of the maximum likelihood classifier because it would all be lost in the delineation of very broad soil mapping units. When output from classifications of test site 16 using both algorithms were compared only minor differences resulted (Table 3). The greatest differences occurred in classes 8 and 9 where a shifting of points back and forth apparently took place depending on the classifier used. Visual inspection of the resulting classification maps indicated that the discrepancies between maps were more or less randomly distributed across the test site. Thus little information was lost using the minimum distance algorithm. Cost of using the maximum likelihood classifier on test site 16 as indicated by computer time (CPU) was more than twice the cost of using minimum distance (38 vs 14 seconds, respectively). This also supported the decision to use minimum distance for all further classifications on this project.

Classification maps and acreage summaries of each test site were obtained. The classification maps were printed (GRESULTS) using a Varian dot matrix printer. The printouts were scaled to 1:30,000 by adjustment of the symbols used to represent each class (Fig. 8). This scale was selected because it corresponded closely to the scale indicated on aerial photography of the test sites that was available from the Riverside office of the BLM. These spectral maps could then be used in the field in conjunction with the aerial photographs without major scale adjustment.

In comparing the distribution of pixels for the test sites among the 15 classes (Table 4) used in the classification with the clusters developed for each test site (Fig. 7) it was apparent that the local features were identified on the classification maps.

FIELD CHECKING OF TEST SITE MAPS

Classification maps of the test sites were taken to the field to determine what features (soil, landforms, surface cover, etc.) could be identified as contributing to spectral characteristics of the classes and to what extent information classes could be associated with the spectral classes. Because the test sites were selected randomly, accessibility to the sites was not a consideration at the time of selection. As a result four of the sites were inaccessible and not field checked (16, 53, 94, 95). The accessibility of other sites was

limited and field checking was a very time consuming process. This limited the field investigation phase of the project to some extent.

During the field checking process, areas that appeared to be spectrally homogeneous on the classification maps were identified and examined. This was accomplished with varying degrees of success. The results of field checking some of the test sites are summarized in the following.

----- The spectral maps which covered limited land areas were difficult to work with as it was not possible to overlay topographic maps to aid in locating ground position. The scale of the aerial photography varied from 1:31,000 to 1:35,000 which also made it difficult to directly relate the spectral maps to the photographs as a means of locating ground position. The combination of topographic maps at 1:24,000 not being available and LARSYS output scaled to 1:24,000 limited easy use of the spectral data. In the studies described previously (Ford Co., Ill., and Big Desert Area, Idaho) 1:24,000 maps were available for direct overlay and made the field investigation phase more productive with limited resources.

----- The amount of detail given on the spectral maps was somewhat excessive. The occurrence of spectrally homogenous areas was limited which made it necessary to look at associations of classes as much as at individual classes.

----- A variety of types of surface cover ranging from rock rubble to well defined desert pavement are present in some of the test sites. In some cases the rock rubble which is associted with Torriorthents is not distinguished (at least not in an obvious

way) spectrally from the desert pavement which is associated with Haplargids and Paleargids. The spectral maps are quite effective in differentiating between areas of desert pavement and areas where pavement is not present.

----- The ability to transfer information classes (interpretation of what the spectral class identifies) from one test area to another decreases as the distance between them increases. General trends hold but specific properties may vary. What is Torripsamments in one area may be Torriorthents in another. This suggested that the spectral maps need to be used on a more local basis and that one should not expect class 5, for example, to mean the same thing everywhere across the study area.

----- The dune areas in test sites 14, 20, 32, 87, 88 were not identified to the degree that one would anticipate. Active dune areas were not readily distinguished from stable dunes and alluvial fan material in many cases. If this differentiation is necessary, more extensive field checking may be necessary or aerial photographs may prove useful.

REEVALUATION OF SPECTRAL CLASSES

On the basis of the field investigations it was decided that some spectral classes could be combined without excessive loss of detail. An attempt was also made to improve the differentiation of dune areas.

For the combination of classes, the SEPERABILITY output for the classes given in Table 1 was reexamined. As discussed previously, classes 5 & 6, 6 & 7, 7 & 8, 8 & 9, and 9 & 10 had divergence values of < 1500. However, only classes 8 and 9 were merged originally so that a maximum amount of detail could be retained. Field investigations indicated that this detail was not necessary and may in some cases be confusing. Therefore, classes 5 & 6, 7 & 8 and 9 & 10 were merged (MERGESTATISTICS) to reduce the original 16 classes to 13 (Table 5).

In an attempt to identify dune areas more specifically, additional data points were clustered from around test sites 20 and 32 to obtain a high reflecting class. Field checking had indicated that active dune areas were generally associated with class 1. The area around test sites 20 and 32 was selected because clustering data obtained from these individual test sites had classes with very high magnitudes (Fig. 7). This new cluster class had a magnitude of 306.43, a ratio of 1.406 and contained 210 points. This class was merged with the original class 1 (Table 1) to form a new class 1 (Table 5).

The thirteen classes that resulted from merges after field checking were all separable (using a divergence value of > 1500 as the criteria). The minimum divergence value was 1555 for classes 3 & 4. The average transformed divergence for all possible combinations of the 13 classes was 1938 out of a maximum of 2000. This was considered to be quite satisfactory.

CLASSIFICATION OF PROJECT AREA

The entire project area was classified (CLASSIFYPOINTS) using a minimum distance algorithm and the 13 classes described in Table 5. Because of the problem with orientation of lines and columns discussed previously it was necessary to classify an area larger than the study area to ensure that the entire study area was classified. The distribution of pixels among the 13 spectral classes for the final classification is given in Table 6.

PRINTING OF SPECTRAL MAPS

Each of the six 15' quadrangles making up the study area was divided into four parts (Table 7). These were designated as the northwest (NW), northeast (NE), southwest (SW), and southeast (SE) parts. The land area covered by each of these parts is equivalent to the area that would be covered by a 7.5' series quadrangle if it existed. By dividing the study area in this way, spectral maps of the study area could be printed at a scale of 1:24,000. The final spectral maps (24) of the study area were printed using the Varian dot matrix printer and are separate from this report. Each symbol (height 0.125" x width 0.1") on the map represents a pixel with ground dimensions of 250 feet by 200 feet. The symbols assigned to each spectral class (Table 5) used in the final classification are shown in Fig. 9.

ASSIGNMENT OF INFORMATION CLASSES TO SPECTRAL CLASSES

Combining information used in this project with information developed during it allowed some inferences to be made about the characteristics of surfaces and landscapes generally represented by each class. These relationships between surface characteristics and spectral classes were very general and possibly misleading, therefore they are not reported here. Only when the spectral maps are used more extensively in the field can more definitive relationships be established.

POTENTIAL USES OF SPECTRAL MAPS

Potential applications of the spectral maps for the Chuckwalla Valley area have not been fully evaluated. The intent of this project was to investigate the possible use of spectral data as an aid to soil survey of the California Desert. Through the development process described in this report it become obvious that spectral maps cannot be translated directly into soil maps. However, at the same time it is evident that the spectral data delineate features such as mountainous areas, desert pavement, active drainage ways dissecting alluvial fans with desert pavement, and sandy areas that may be interpreted relative to soil mapping units.

By comparing the spectral maps for this study area with geologic maps, topographic maps. aerial photographs and field notes, it is

evident that many of the factors that go into the design of mapping units for a low intensity survey are "built in" the spectral classes. As such they should prove useful to a soil scientist conducting a survey in the desert area.

As pointed out previously, details of relationships between pixel composition and spectral classes have not been worked out during this project. This points out a deficiency in this study as it was not part of the design to have a soil scientist actively working on a soil survey in the area during the development of spectral data. This would have been necessary to generate a detailed evaluation. Through the general field checking that was done and evaluation of other data sources, it is apparent that the additional source of data available in spectral maps will aid soil survey operations. However, the extent of aid can only be fully evaluated by the soil scientist doing the actual soil survey. The maps are now available. A more complete evaluation may be possible in the future if a soil survey is initiated in the Chuckwalla Valley area.

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Table 1. Spectral characteristics of classes developed by clustering 1% sample of project area.

CLUSTER CLASS	MEAN REFLECTANCE Band 4	Band 5	Band 6	Band 7	Magnitude	VIS/IR	Number of points
1	76.82	95.91	88.38	34.47	295.58	1.406	346
2	72.16	87.65	81.22	31.63	272.67	1.416	596
3	69.27	81.63	75.31	29.13	255.34	1.445	664
4	65.98	76.55	70.21	27.27	240.00	1.462	658
5	63.16	71.72	66.30	25.75	226.93	1.465	772
6	61.54	68.56	62.14	24.00	216.24	1.510	446
7	57.14	65.36	60.75	24.00	207.25	1.446	421
8	58.15	63.24	56.53	21.80	199.72	1.550	402
9	53.18	60.05	56.12	22.04	191.39	1.449	396
10	54.06	58.01	52.19	19.96	184.23	1.553	428
11	50.40	54.48	49.91	19.09	173.89	1.520	586
12	47.84	51.08	46.10	17.58	162.60	1.553	671
13	44.58	46.74	42.68	16.15	150.16	1.552	775
14	41.41	42.48	38.34	14.54	136.77	1.586	724
15	37.56	36.92	33.15	12.57	120.21	1.629	639
16	31.63	28.77	25.20	9.25	94.85	1.754	292

Table 2. Spectral characteristics of classes used in preliminary classification of test sites. These data resulted from merging of classes 8 & 9 in Table 1.

MERGED CLASS	MEAN REFLECTANCE Band 4	Band 5	Band 6	Band 7	Magnitude	VIS/IR	Number of points
1	76.82	95.91	88.38	34.47	295.58	1.406	346
2	72.16	87.65	81.22	31.63	272.67	1.416	596
3	69.27	81.63	75.31	29.13	255.34	1.445	664
4	65.98	76.55	70.21	27.27	240.00	1.462	658
5	63.16	71.72	66.30	25.75	226.93	1.465	772
6	61.54	68.56	62.14	24.00	216.24	1.510	446
7	57.14	65.36	60.75	24.00	207.25	1.446	421
8	55.68	61.66	56.33	21.92	195.59	1.500	798
9	54.06	58.01	52.19	19.96	184.23	1.553	428
10	50.40	54.48	49.91	19.09	173.89	1.520	586
11	47.84	51.08	46.10	17.58	162.60	1.553	671
12	44.58	46.74	42.68	16.15	150.16	1.552	775
13	41.41	42.48	38.34	14.54	136.77	1.586	724
14	37.56	36.92	33.15	12.57	120.21	1.629	639
15	31.63	28.77	25.20	9.25	94.85	1.754	292

Table 3. Comparison of results obtained by minimum distance and maximum likelihood classifiers when applied to test site 16.

SPECTRAL CLASS†	Pixels in class by Minimum distance	Maximum likelihood
	%	%
1	0.0	0.0
2	0.1	0.1
3	0.4	0.4
4	2.0	2.2
5	5.5	5.3
6	5.6	5.5
7	5.9	5.9
8	8.4	10.0
9	9.1	8.0
10	11.0	10.2
11	14.0	14.0
12	11.5	11.3
13	9.4	9.6
14	10.1	9.7
15	6.9	7.6

†Classes same as those in Table 2.

Table 4. Distribution of pixels for each test site among 15 spectral classes. Area breakdowns for each class in each test site are given in Appendix 2.

SPECTRAL CLASS	TEST SITE 14	16	20	32	39	47	53	55	69	87	88	91	94	95	103
1	.4	.0	28.6	29.9	.0	.0	.0	1.0	.0	.1	.4	.0	.0	.0	.0
2	13.3	.1	53.8	28.6	.0	.0	.0	0.7	1.4	.4	2.3	.0	.0	.0	.0
3	26.8	.4	15.7	10.9	.0	2.9	.0	1.6	15.6	6.8	4.9	.8	.0	.0	.0
4	21.1	2.0	1.8	4.9	.4	8.2	.0	3.5	17.9	30.9	40.8	12.0	.0	.0	.1
5	14.1	5.5	0.2	3.8	2.4	10.7	.0	9.6	14.5	21.7	41.7	29.1	.0	.0	1.8
6	6.8	5.6	.0	3.4	4.8	27.8	.0	8.3	17.9	8.5	6.0	29.8	.1	.1	3.6
7	9.3	5.9	.0	1.0	11.2	9.6	.0	1.9	5.7	11.9	3.2	9.9	.6	.7	5.0
8	5.9	8.4	.0	2.4	13.9	17.9	.0	1.3	10.0	13.0	0.6	13.8	1.6	1.9	16.2
9	1.7	9.1	.0	4.5	10.0	9.7	.3	2.2	5.6	3.8	.0	3.7	3.6	3.5	17.6
10	.4	11.0	.0	4.3	12.7	4.4	1.5	3.0	4.4	2.0	.0	0.8	12.9	10.1	18.7
11	.0	14.0	.0	5.0	14.8	2.4	11.3	6.8	4.7	0.7	.0	0.1	17.7	15.3	24.1
12	.0	11.5	.0	1.2	13.9	1.8	27.9	12.2	1.8	0.1	.0	.0	22.3	22.2	11.3
13	.0	9.4	.0	.2	10.8	2.3	31.2	18.0	0.3	.0	.0	.0	18.0	20.4	1.4
14	.0	10.1	.0	.0	3.6	1.8	17.3	16.8	.0	.0	.0	.0	15.8	19.5	.0
15	.0	6.9	.0	.0	1.5	.5	10.5	13.0	.0	.0	.0	.0	7.4	6.4	.0

Table 5. Spectral characteristics of classes used for final classification of project area. These data resulting from merging of 16 original cluster classes (Table 1) to 13 and adding a high reflecting class clustered from a sample around test sites 20 and 36.

MERGED	MEAN REFLECTANCE						Number
CLASS	Band 4	Band 5	Band 6	Band 7	Magnitude	VIS/IR	of points
1	76.82	95.91	88.38	34.47	295.58	1.406	346
2	72.16	87.65	81.22	31.63	272.67	1.416	596
3	69.27	81.63	75.31	29.13	255.34	1.445	664
4	65.98	76.55	70.21	27.27	240.00	1.462	658
5	62.57	70.56	64.77	25.11	223.01	1.481	1218
6	57.63	64.33	58.69	22.93	203.57	1.494	823
7	53.64	58.99	54.08	20.96	187.67	1.501	824
8	50.40	54.48	49.91	19.09	173.89	1.520	586
9	47.84	51.08	46.10	17.58	162.60	1.553	671
10	44.58	46.74	42.68	16.15	150.16	1.552	775
11	41.41	42.48	38.34	14.54	136.77	1.586	724
12	37.56	36.92	33.15	12.57	120.21	1.629	639
13	31.63	28.77	25.20	9.25	94.85	1.754	292

Table 6. Distribution of pixels for the project area among 13 spectral classes. The spectral characteristics of each class are given in Table 5.

SPECTRAL CLASS	PIXELS	ACRES	HECTARES	%
1	29,904	34,389	13,923	3.4
2	63,049	72,506	29,355	7.2
3	64,840	74,566	30,189	7.4
4	78,998	90,848	36,780	9.1
5	108,155	124,378	50,356	12.4
6	92,214	106,046	42,934	10.6
7	72,099	82,914	33,568	8.3
8	61,945	71,237	28,841	7.1
9	67,995	78,194	31,658	7.8
10	75,726	87,085	35,257	8.7
11	76,305	83,151	33,664	8.3
12	56,811	65,333	26,450	6.5
13	27,870	32,050	12,976	3.2
TOTAL	871,911	1,002,697	405,951	

Table 7. Coordinates of final spectral maps for study area.

MAP SHEET		Coordinates	
		West Longitude	North Latitude
COXCOMB MTS.	NW	115° 22'30"-115° 30'00"	33° 52'30"-34° 00'00"
COXCOMB MTS.	NE	115° 15'00"-115° 22'30"	33° 52'30"-34° 00'00"
COXCOMB MTS.	SW	115° 22'30"-115° 30'00"	33° 45'00"-33° 52'30"
COXCOMB MTS.	SE	115° 15'00"-115° 22'30"	33° 45'00"-33° 52'30"
PALEN MTS.	NW	115° 07'30"-115° 15'00"	33° 52'30"-34° 00'00"
PALEN MTS.	NE	115° 00'00"-115° 07'30"	33° 52'30"-34° 00'00"
PALEN MTS.	SW	115° 07'30"-115° 15'00"	33° 45'00"-33° 52'30"
PALEN MTS.	SE	115° 00'00"-115° 07'30"	33° 45'00"-33° 52'30"
MIDLAND	NW	114° 52'30"-115° 00'00"	33° 52'30"-34° 00'00"
MIDLAND	NE	114° 45'00"-114° 52'30"	33° 52'30"-34° 00'00"
MIDLAND	SW	114° 52'30"-115° 00'00"	33° 45'00"-33° 52'30"
MIDLAND	SE	114° 45'00"-114° 52'30"	33° 45'00"-33° 52'30"
CHUCKWALLA MTS.	NW	115° 22'30"-115° 30'00"	33° 37'30"-33° 45'00"
CHUCKWALLA MTS.	NE	115° 15'00"-115° 22'30"	33° 37'30"-33° 45'00"
CHUCKWALLA MTS.	SW	115° 22'30"-115° 30'00"	33° 30'00"-33° 37'30"
CHUCKWALLA MTS.	SE	115° 15'00"-115° 22'30"	33° 30'00"-33° 37'30"
SIDEWINDER WELL	NW	115° 07'30"-115° 15'00"	33° 37'30"-33° 45'00"
SIDEWINDER WELL	NE	115° 00'00"-115° 07'30"	33° 37'30"-33° 45'00"
SIDEWINDER WELL	SW	115° 07'30"-115° 15'00"	33° 30'00"-33° 37'30"
SIDEWINDER WELL	SE	115° 00'00"-115° 07'30"	33° 30'00"-33° 37'30"
MC COY SPRING	NW	114° 52'30"-115° 00'00"	33° 37'30"-33° 45'00"
MC COY SPRING	NE	114° 45'00"-114° 52'30"	33° 37'30"-33° 45'00"
MC COY SPRING	SW	114° 52'30"-115° 00'00"	33° 30'00"-33° 37'30"
MC COY SPRING	SE	114° 45'00"-114° 52'30"	33° 30'00"-33° 37'30"

FIGURES

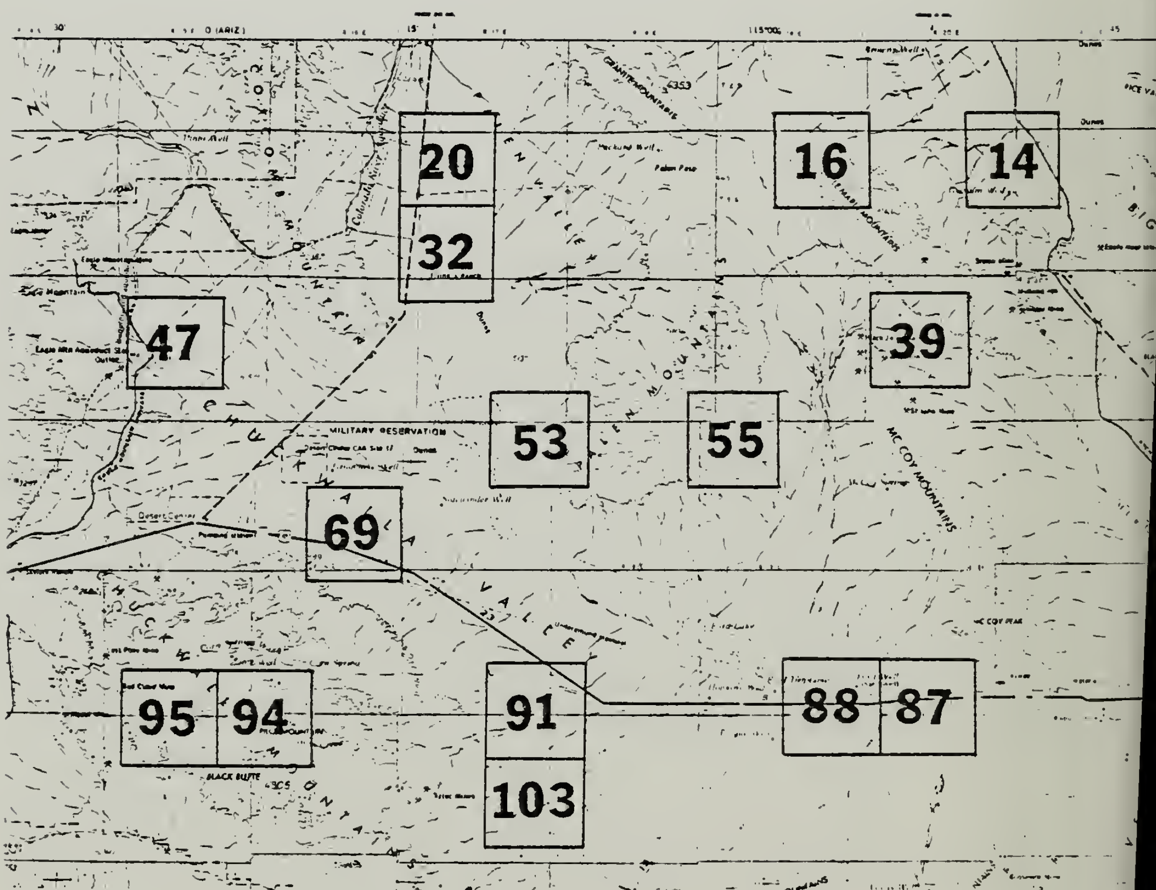

Fig. 6. Locations of test sites. Each site contains 9200 acres.

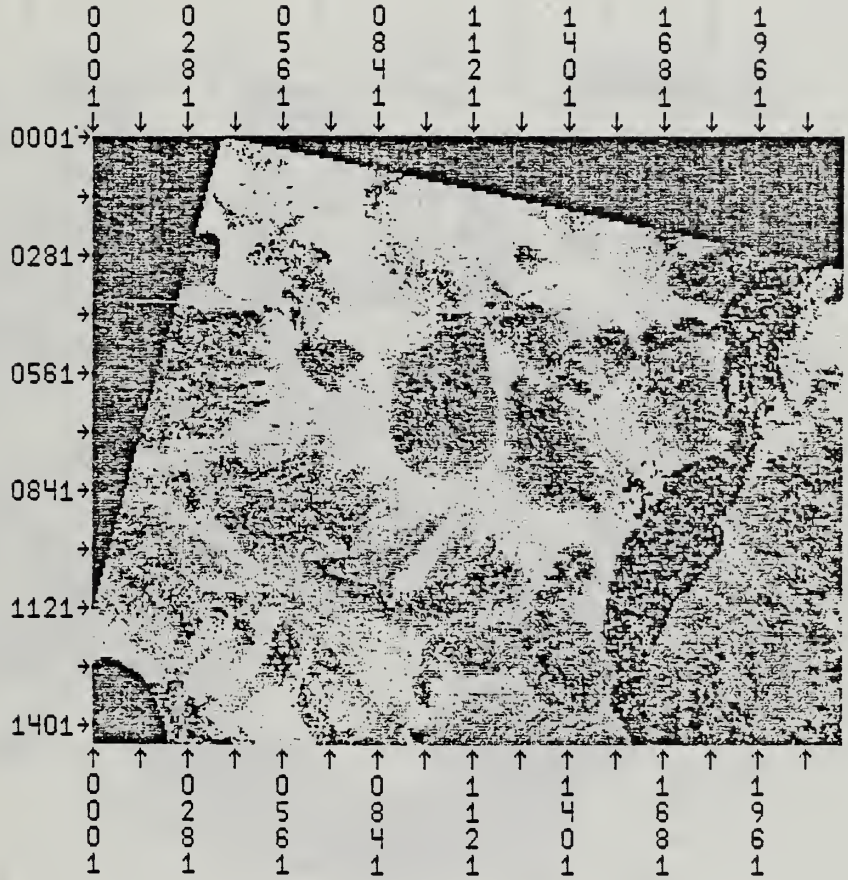

Fig. 5. Grayscale of band 5 for portion of Landsat scene that was geometrically corrected and rescaled. The Chuckwalla Valley is the white band running upper left to lower right centered around line and column 561.

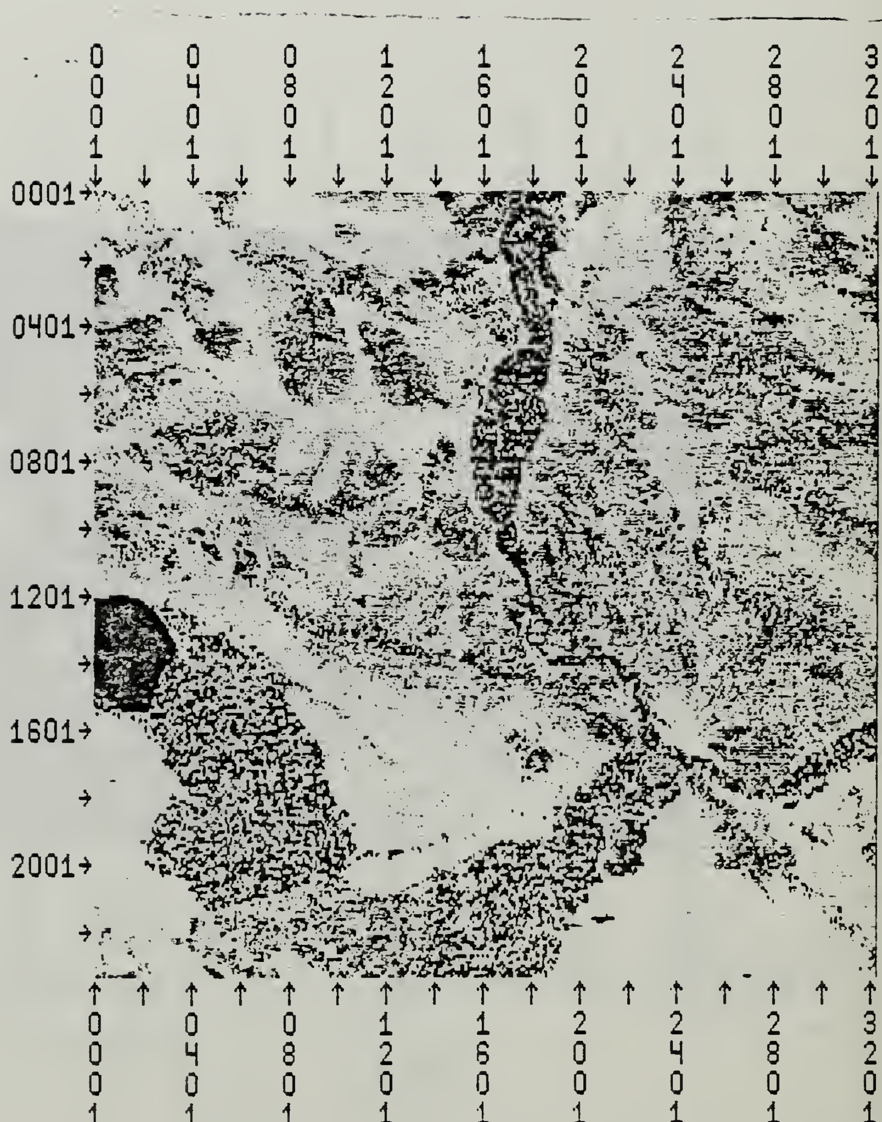

Fig. 4. Grayscale of band 5 for Landsat scene 5473-16551.

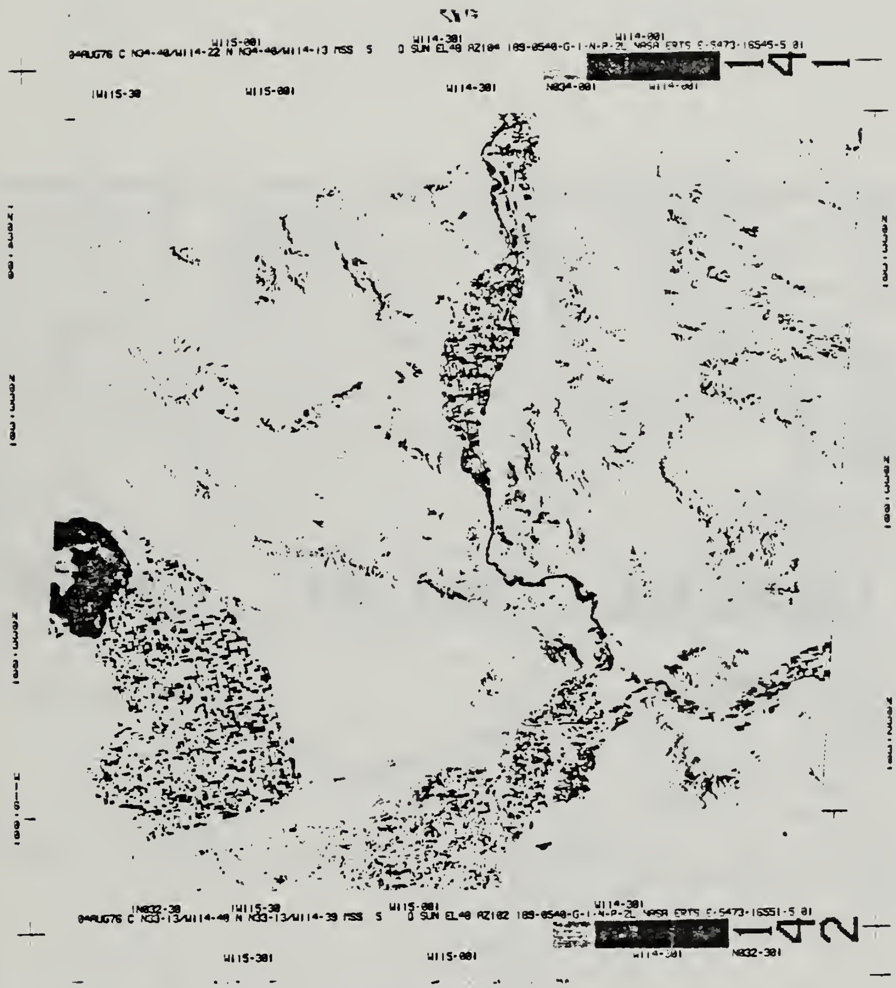

Fig. 3. Landsat image covering eastern California Desert. This image is band 5 of scene 5473-16551. Imperial Valley is located in lower left below the Salton Sea. The Colorado River and Palo Verde Valley cross the center. The study area is located in the upper left quadrant.

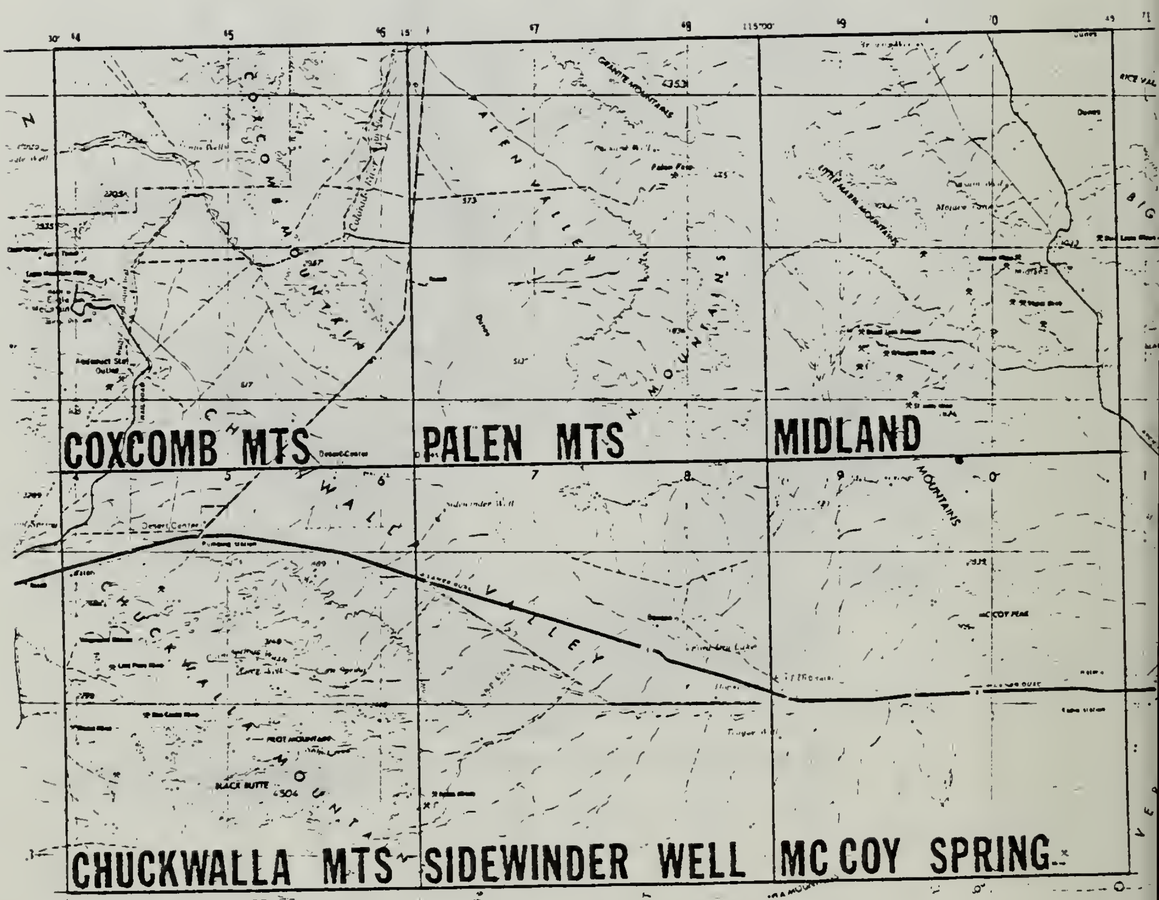

Fig. 2. Quadrangles included as study area. Only 15' quadrangles (1:62,500) of the more detailed series were available for this area.

Fig. 1. Topographic map (1:250,000) of region around Chuckwalla Valley. This map is a reproduction of a portion of the USGS 1:250,000 Salton Sea sheet.

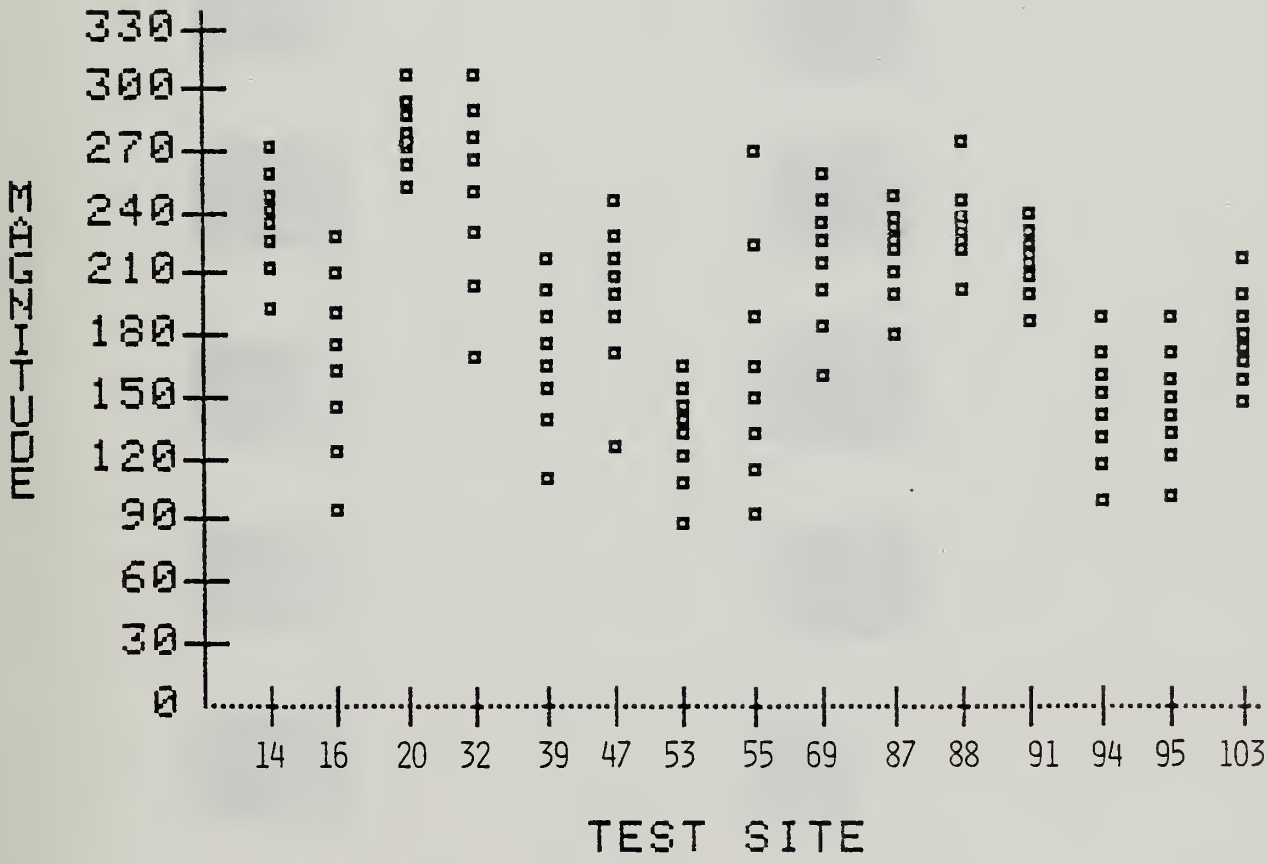

Fig. 7. Distribution of cluster classes for fifteen test sites.

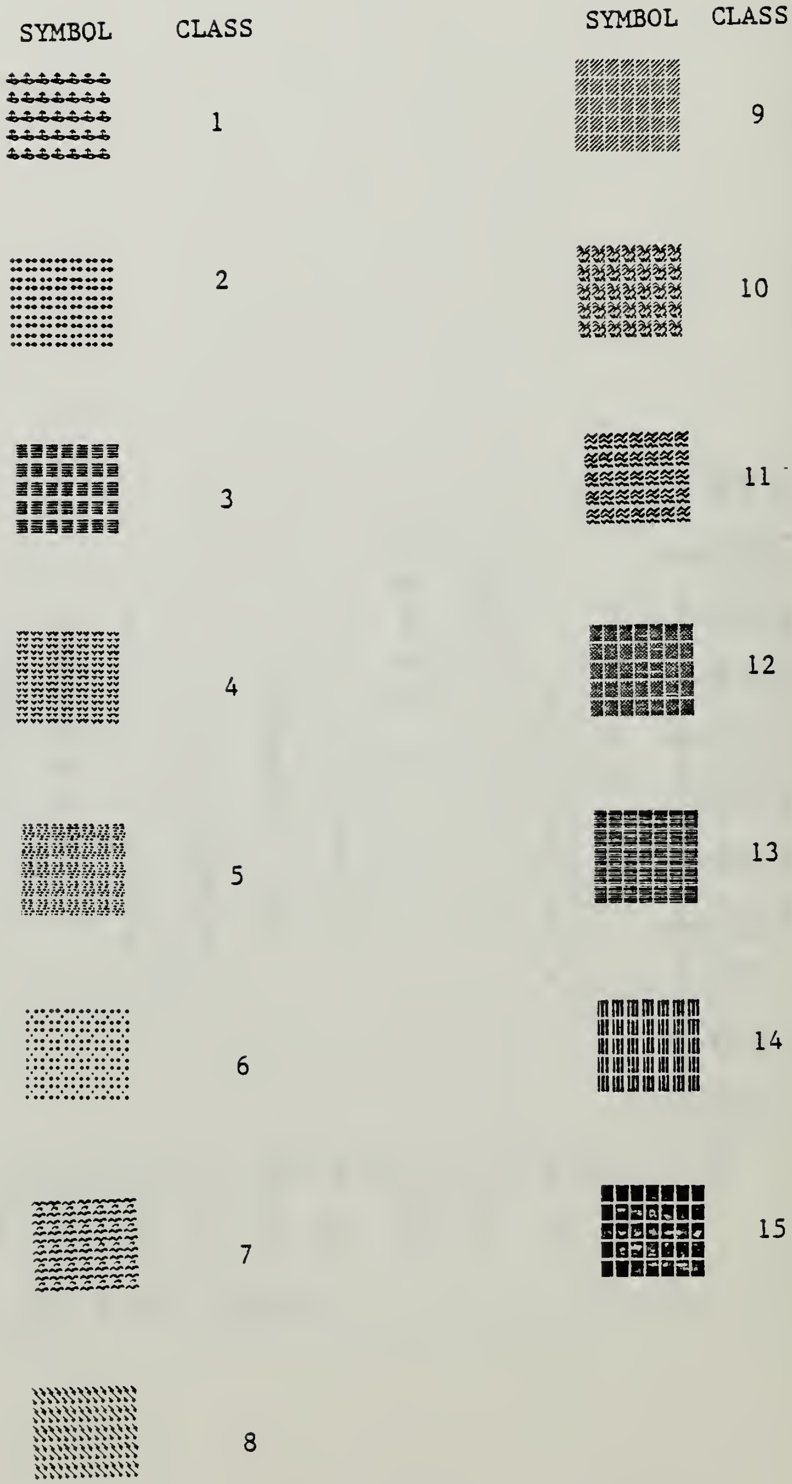

Fig. 8. Symbols assigned to spectral classes used in classification of test sites.

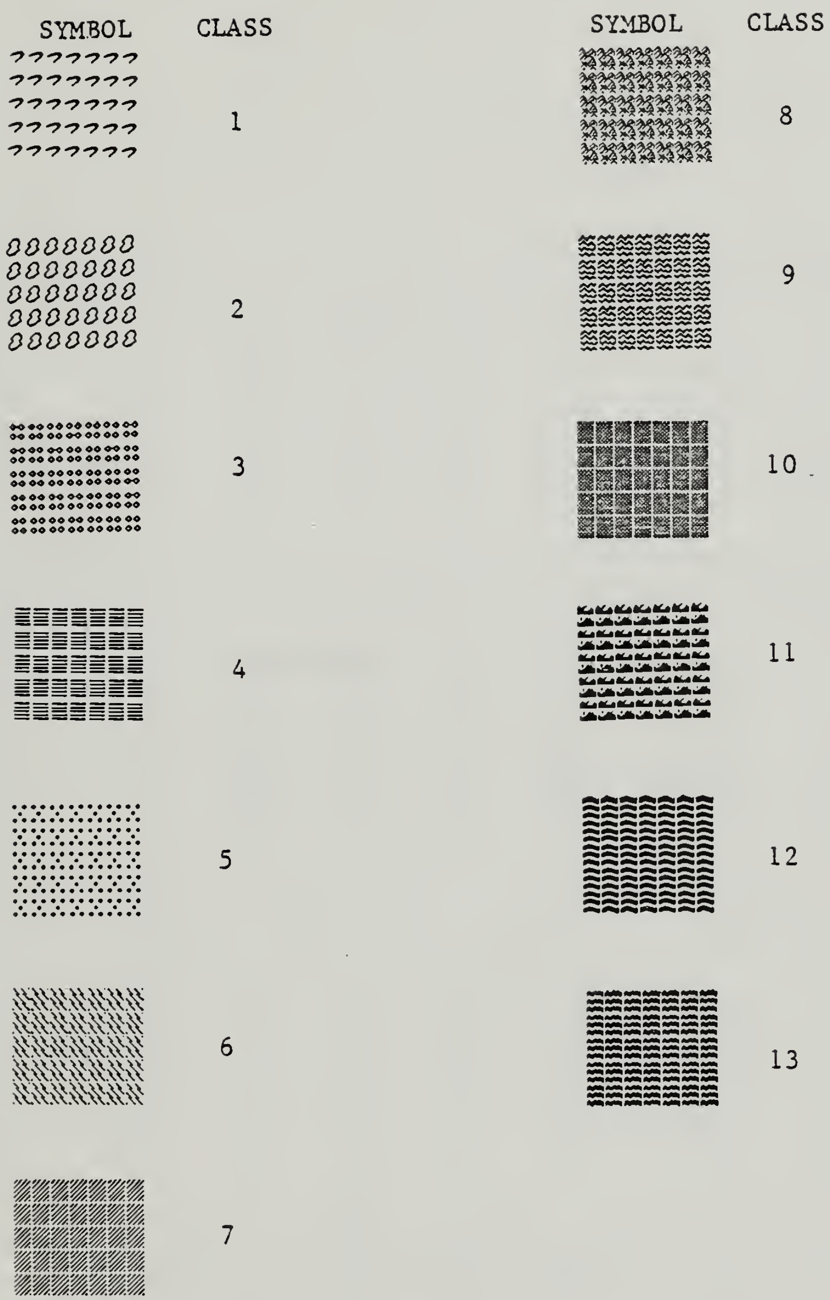

Fig. 9. Symbols assigned to 13 spectral classes on final spectral maps.

APPENDIX

CLUSTERING OF 6% SAMPLE FOR TEST SITE 14

****************************** ORDERED BY CLASS ******************************

NO.	SYMBOLS	CLASS	CHAN 1	CHAN 2	CHAN 3	CHAN 4	MAGNITUDE	VIS/IR	PCT.VIS	PCT.IR
1	.	AA- 1/ 8	68.40	88.36	82.84	32.49	272.09	1.3593	57.61	42.39
2	-	AA- 2/ 8	66.33	83.65	78.57	30.37	258.92	1.3767	57.92	42.08
3	=	AA- 3/ 8	64.65	79.91	75.14	29.35	249.05	1.3835	58.04	41.96
4	/	AA- 4/ 8	63.78	78.25	71.17	28.60	242.00	1.4255	58.77	41.23
5	O	AA- 5/ 8	62.94	73.82	70.53	27.37	234.65	1.3969	58.28	41.72
6	A	AA- 6/ 8	62.00	71.83	65.92	26.60	226.35	1.4465	59.12	40.88
7	Y	AA- 7/ 8	58.78	67.49	61.96	24.19	212.41	1.4657	59.44	40.56
8	M	AA- 8/ 8	55.02	61.47	55.51	22.02	194.02	1.5025	60.04	39.96

****************************** ORDERED BY MAGNITUDE ******************************

NO.	SYMBOLS	CLASS	CHAN 1	CHAN 2	CHAN 3	CHAN 4	MAGNITUDE	VIS/IR	PCT.VIS	PCT.IR
8	M	AA- 8/ 8	55.02	61.47	55.51	22.02	194.02	1.5025	60.04	39.96
7	Y	AA- 7/ 8	58.78	67.49	61.96	24.19	212.41	1.4657	59.44	40.56
6	A	AA- 6/ 8	62.00	71.83	65.92	26.60	226.35	1.4465	59.12	40.88
5	O	AA- 5/ 8	62.94	73.82	70.53	27.37	234.65	1.3969	58.28	41.72
4	/	AA- 4/ 8	63.98	78.25	71.17	28.60	242.00	1.4255	58.77	41.23
3	=	AA- 3/ 8	64.65	79.91	75.14	29.35	249.05	1.3835	58.04	41.76
2	-	AA- 2/ 8	66.33	83.65	78.57	30.37	258.92	1.3767	57.92	42.08
1	.	AA- 1/ 8	68.40	88.36	82.84	32.49	272.09	1.3593	57.61	42.39

****************************** ORDERED BY RATIO ******************************

NO.	SYMBOLS	CLASS	CHAN 1	CHAN 2	CHAN 3	CHAN 4	MAGNITUDE	VIS/IR	PCT.VIS	PCT.IR
1	.	AA- 1/ 8	68.40	88.36	82.84	32.49	272.09	1.3593	57.61	42.39
2	-	AA- 2/ 8	66.33	83.65	78.57	30.37	258.92	1.3767	57.92	42.08
3	=	AA- 3/ 8	64.65	79.91	75.14	29.35	249.05	1.3835	58.04	41.76
5	O	AA- 5/ 8	62.94	73.82	70.53	27.37	234.65	1.3969	58.28	41.72
4	/	AA- 4/ 8	63.78	78.25	71.17	28.60	242.00	1.4255	58.77	41.23
6	A	AA- 6/ 8	62.00	71.83	65.92	26.60	226.35	1.4465	59.12	40.88
7	Y	AA- 7/ 8	58.78	67.49	61.96	24.19	212.41	1.4657	59.44	40.56
8	M	AA- 8/ 8	55.02	61.47	55.51	22.02	194.02	1.5025	60.04	39.96

******************** VARIANCES ********************

NO.	SYMBOLS	CLASS	CHAN 1	CHAN 2	CHAN 3	CHAN 4	NO. POINTS
1	.	AA- 1/ 8	4.17	5.46	4.66	4.33	55
2	-	AA- 2/ 8	3.33	3.17	3.64	2.94	86
3	=	AA- 3/ 8	2.48	3.07	1.43	3.75	88
4	/	AA- 4/ 8	2.25	1.04	2.26	3.67	53
5	O	AA- 5/ 8	1.81	2.36	3.05	3.36	49
6	A	AA- 6/ 8	1.88	2.62	2.31	2.87	52
7	Y	AA- 7/ 8	3.32	4.37	3.75	2.04	68
8	M	AA- 8/ 8	5.06	6.17	10.09	3.85	49

CLUSTERING OF 6% SAMPLE FOR TEST SITE 16

******************************** ORDERED BY CLASS ********************************

NO.	SYMBOLS	CLASS	CHAN 1	CHAN 2	CHAN 3	CHAN 4	MAGNITUDE	VIS/IR	PCT.VIS	PCT.IR
1	.	BB- 1/ 8	63.31	72.03	66.22	26.15	227.71	1.4651	59.43	40.57
2	-	BB- 2/ 8	59.00	66.06	60.73	23.79	209.58	1.4776	59.67	40.33
3	=	BB- 3/ 8	54.27	60.56	55.14	21.00	190.97	1.5080	60.13	39.87
4	/	BB- 4/ 8	50.75	55.61	50.57	19.54	176.46	1.5173	60.27	39.73
5	0	BB- 5/ 8	47.64	51.13	46.49	17.77	163.03	1.5371	60.59	39.41
6	A	BB- 6/ 8	43.50	46.01	41.16	15.40	146.07	1.5826	61.28	38.72
7	Y	BB- 7/ 8	38.53	37.78	33.83	12.78	122.93	1.6371	62.08	37.92
8	M	BB- 8/ 8	31.76	28.89	24.84	9.22	94.70	1.7810	64.04	35.96

******************************** ORDERED BY MAGNITUDE ********************************

NO.	SYMBOLS	CLASS	CHAN 1	CHAN 2	CHAN 3	CHAN 4	MAGNITUDE	VIS/IR	PCT.VIS	PCT.IR
8	M	BB- 8/ 8	31.76	28.89	24.84	9.22	94.70	1.7810	64.04	35.96
7	Y	BB- 7/ 8	38.53	37.78	33.83	12.78	122.93	1.6371	62.08	37.92
6	A	BB- 6/ 8	43.50	46.01	41.16	15.40	146.07	1.5826	61.28	38.72
5	0	BB- 5/ 8	47.64	51.13	46.49	17.77	163.03	1.5371	60.59	39.41
4	/	BB- 4/ 8	50.75	55.61	50.57	19.54	176.46	1.5173	60.27	39.73
3	=	BB- 3/ 8	54.27	60.56	55.14	21.00	190.97	1.5080	60.13	39.87
2	-	BB- 2/ 8	59.00	66.06	60.73	23.79	209.58	1.4776	59.67	40.33
1	.	BB- 1/ 8	63.31	72.03	66.22	26.15	227.71	1.4651	59.43	40.57

******************************** ORDERED BY RATIO ********************************

NO.	SYMBOLS	CLASS	CHAN 1	CHAN 2	CHAN 3	CHAN 4	MAGNITUDE	VIS/IR	PCT.VIS	PCT.IR
1	.	BB- 1/ 8	63.31	72.03	66.22	26.15	227.71	1.4651	59.43	40.57
2	-	BB- 2/ 8	59.00	66.06	60.73	23.79	209.58	1.4776	59.67	40.33
3	=	BB- 3/ 8	54.27	60.56	55.14	21.00	190.97	1.5080	60.13	39.87
4	/	BB- 4/ 8	50.75	55.61	50.57	19.54	176.46	1.5173	60.27	39.73
5	0	BB- 5/ 8	47.64	51.13	46.49	17.77	163.03	1.5371	60.59	39.41
6	A	BB- 6/ 8	43.50	46.01	41.16	15.40	146.07	1.5826	61.28	38.72
7	Y	BB- 7/ 8	38.53	37.78	33.83	12.78	122.93	1.6371	62.08	37.92
8	M	BB- 8/ 8	31.76	28.89	24.84	9.22	94.70	1.7810	64.04	35.96

******************** VARIANCES ********************

NO.	SYMBOLS	CLASS	CHAN 1	CHAN 2	CHAN 3	CHAN 4	NO. POINTS
1	.	BB- 1/ 8	8.42	7.59	11.30	4.20	59
2	-	BB- 2/ 8	5.29	5.12	5.18	3.03	52
3	=	BB- 3/ 8	4.20	3.99	3.32	2.52	63
4	/	BB- 4/ 8	3.13	2.74	3.84	2.11	69
5	0	BB- 5/ 8	3.48	3.02	2.33	2.28	78
6	A	BB- 6/ 8	3.81	3.82	4.68	2.05	82
7	Y	BB- 7/ 8	4.29	6.72	5.60	2.31	60
8	M	BB- 8/ 8	5.08	8.27	8.75	1.73	37

CLUSTERING OF 6% SAMPLE FOR TEST SITE 20

****************************** ORDERED BY CLASS ******************************

NO.	SYMBOLS	CLASS	CHAN 1	CHAN 2	CHAN 3	CHAN 4	MAGNITUDE	VIS/IR	PCT.VIS	PCT.IR
1	.	CC- 1/ 8	82.50	98.24	89.85	34.91	305.50	1.4487	59.16	40.84
2	-	CC- 2/ 8	80.13	94.90	84.82	33.93	293.79	1.4739	59.58	40.42
3	=	CC- 3/ 8	77.04	93.02	85.27	32.04	287.38	1.4497	59.18	40.82
4	/	CC- 4/ 8	76.53	89.06	82.55	30.68	278.82	1.4625	59.39	40.61
5	O	CC- 5/ 8	74.99	89.33	78.91	31.33	274.56	1.4906	59.85	40.15
6	A	CC- 6/ 8	75.34	85.35	79.49	30.91	271.09	1.4555	59.28	40.72
7	Y	CC- 7/ 8	72.70	84.57	76.75	29.67	263.69	1.4778	59.64	40.36
8	M	CC- 8/ 8	71.13	80.24	72.85	28.24	252.46	1.4974	59.96	40.04

****************************** ORDERED BY MAGNITUDE ******************************

NO.	SYMBOLS	CLASS	CHAN 1	CHAN 2	CHAN 3	CHAN 4	MAGNITUDE	VIS/IR	PCT.VIS	PCT.IR
8	M	CC- 8/ 8	71.13	80.24	72.85	28.24	252.46	1.4974	59.96	40.04
7	Y	CC- 7/ 8	72.70	84.57	76.75	29.67	263.69	1.4778	59.64	40.36
6	A	CC- 6/ 8	75.34	85.35	79.49	30.91	271.09	1.4555	59.28	40.72
5	O	CC- 5/ 8	74.99	89.33	78.91	31.33	274.56	1.4906	59.85	40.15
4	/	CC- 4/ 8	76.53	89.06	82.55	30.68	278.82	1.4625	59.39	40.61
3	=	CC- 3/ 8	77.04	93.02	85.27	32.04	287.38	1.4497	59.18	40.82
2	-	CC- 2/ 8	80.13	94.90	84.82	33.93	293.79	1.4739	59.58	40.42
1	.	CC- 1/ 8	82.50	98.24	89.85	34.91	305.50	1.4487	59.16	40.84

****************************** ORDERED BY RATIO ******************************

NO.	SYMBOLS	CLASS	CHAN 1	CHAN 2	CHAN 3	CHAN 4	MAGNITUDE	VIS/IR	PCT.VIS	PCT.IR
1	.	CC- 1/ 8	82.50	98.24	89.85	34.91	305.50	1.4487	59.16	40.84
3	=	CC- 3/ 8	77.04	93.02	85.27	32.04	287.38	1.4497	59.18	40.82
6	A	CC- 6/ 8	75.34	85.35	79.49	30.91	271.09	1.4555	59.28	40.72
4	/	CC- 4/ 8	76.53	89.06	82.55	30.68	278.82	1.4625	59.39	40.61
2	-	CC- 2/ 8	80.13	94.90	84.82	33.93	293.79	1.4739	59.58	40.42
7	Y	CC- 7/ 8	72.70	84.57	76.75	29.67	263.69	1.4778	59.64	40.36
5	O	CC- 5/ 8	74.99	89.33	78.91	31.33	274.56	1.4906	59.85	40.15
8	M	CC- 8/ 8	71.13	80.24	72.85	28.24	252.46	1.4974	59.96	40.04

******************** VARIANCES ********************

NO.	SYMBOLS	CLASS	CHAN 1	CHAN 2	CHAN 3	CHAN 4	NO. POINTS
1	.	CC- 1/ 8	6.83	5.43	4.04	4.34	46
2	-	CC- 2/ 8	3.22	2.89	4.42	3.56	61
3	=	CC- 3/ 8	2.75	1.48	4.66	1.82	45
4	/	CC- 4/ 8	3.09	0.43	2.38	2.74	66
5	O	CC- 5/ 8	2.79	0.55	1.57	4.50	75
6	A	CC- 6/ 8	2.23	0.38	2.25	3.85	80
7	Y	CC- 7/ 8	2.66	2.47	2.39	2.55	81
8	M	CC- 8/ 8	2.56	3.83	10.62	3.56	46

CLUSTERING OF 6% SAMPLE FOR TEST SITE 32

****************************** ORDERED BY CLASS ******************************

NO.	SYMBOLS	CLASS	CHAN 1	CHAN 2	CHAN 3	CHAN 4	MAGNITUDE	VIS/IR	PCT.VIS	PCT.IR
1	.	DD- 1/ 8	80.49	98.45	91.47	36.18	306.59	1.4018	58.37	41.63
2	-	DD- 2/ 8	77.02	93.60	86.13	33.75	290.49	1.4233	58.73	41.27
3	=	DD- 3/ 8	73.62	88.52	82.38	32.27	276.79	1.4142	58.58	41.42
4	/	DD- 4/ 8	70.68	84.02	79.32	30.70	264.71	1.4061	58.44	41.56
5	0	DD- 5/ 8	68.97	79.42	73.97	28.61	250.97	1.4466	59.13	40.87
6	A	DD- 6/ 8	65.61	72.15	66.79	25.82	230.36	1.4876	59.80	40.20
7	Y	DD- 7/ 8	60.91	64.34	57.81	22.25	205.31	1.5644	61.00	39.00
8	M	DD- 8/ 8	52.99	52.99	46.68	17.25	169.91	1.6575	62.37	37.63

****************************** ORDERED BY MAGNITUDE ******************************

NO.	SYMBOLS	CLASS	CHAN 1	CHAN 2	CHAN 3	CHAN 4	MAGNITUDE	VIS/IR	PCT.VIS	PCT.IR
8	M	DD- 8/ 8	52.99	52.99	46.68	17.25	169.91	1.6575	62.37	37.63
7	Y	DD- 7/ 8	60.91	64.34	57.81	22.25	205.31	1.5644	61.00	39.00
6	A	DD- 6/ 8	65.61	72.15	66.79	25.82	230.36	1.4876	59.80	40.20
5	0	DD- 5/ 8	68.97	79.42	73.97	28.61	250.97	1.4466	59.13	40.87
4	/	DD- 4/ 8	70.68	84.02	79.32	30.70	264.71	1.4061	58.44	41.56
3	=	DD- 3/ 8	73.62	88.52	82.38	32.27	276.79	1.4142	58.58	41.42
2	-	DD- 2/ 8	77.02	93.60	86.13	33.75	290.49	1.4233	58.73	41.27
1	.	DD- 1/ 8	80.49	98.45	91.47	36.18	306.59	1.4018	58.37	41.63

****************************** ORDERED BY RATIO ******************************

NO.	SYMBOLS	CLASS	CHAN 1	CHAN 2	CHAN 3	CHAN 4	MAGNITUDE	VIS/IR	PCT.VIS	PCT.IR
1	.	DD- 1/ 8	80.49	98.45	91.47	36.18	306.59	1.4018	58.37	41.63
4	/	DD- 4/ 8	70.68	84.02	79.32	30.70	264.71	1.4061	58.44	41.56
3	=	DD- 3/ 8	73.62	88.52	82.38	32.27	276.79	1.4142	58.58	41.42
2	-	DD- 2/ 8	77.02	93.60	86.13	33.75	290.49	1.4233	58.73	41.27
5	0	DD- 5/ 8	68.97	79.42	73.97	28.61	250.97	1.4466	59.13	40.87
6	A	DD- 6/ 8	65.61	72.15	66.79	25.82	230.36	1.4876	59.80	40.20
7	Y	DD- 7/ 8	60.91	64.34	57.81	22.25	205.31	1.5644	61.00	39.00
8	M	DD- 8/ 8	52.99	52.99	46.68	17.25	169.91	1.6575	62.37	37.63

******************** VARIANCES ********************

NO.	SYMBOLS	CLASS	CHAN 1	CHAN 2	CHAN 3	CHAN 4	NO. POINTS
1	.	DD- 1/ 8	7.58	6.57	8.05	6.23	31
2	-	DD- 2/ 8	6.03	3.49	5.07	4.32	120
3	=	DD- 3/ 8	5.38	3.74	6.18	4.84	74
4	/	DD- 4/ 8	6.26	2.93	4.37	3.52	56
5	0	DD- 5/ 8	8.24	3.87	6.84	3.06	38
6	A	DD- 6/ 8	7.75	5.01	7.36	3.84	33
7	Y	DD- 7/ 8	4.60	11.27	11.64	2.77	32
8	M	DD- 8/ 8	10.01	12.79	10.67	3.20	76

CLUSTERING OF 6% SAMPLE FOR TEST SITE 39

****************************** ORDERED BY CLASS ******************************

NO.	SYMBOLS	CLASS	CHAN 1	CHAN 2	CHAN 3	CHAN 4	MAGNITUDE	VIS/IR	PCT.VIS	PCT.IR
1	.	EE- 1/ 8	60.17	69.48	63.96	24.87	218.48	1.4596	59.34	40.66
2	-	EE- 2/ 8	57.27	63.78	58.44	22.60	202.10	1.4937	59.90	40.10
3	=	EE- 3/ 8	53.52	59.34	54.41	20.97	188.25	1.4974	59.96	40.04
4	/	EE- 4/ 8	50.67	55.62	51.20	19.83	177.32	1.4964	59.94	40.06
5	O	EE- 5/ 8	48.38	51.80	47.28	18.25	165.71	1.5290	60.46	39.54
6	A	EE- 6/ 8	45.27	48.14	44.56	16.83	154.81	1.5214	60.34	39.66
7	Y	EE- 7/ 8	40.97	42.87	39.12	14.96	137.91	1.5504	60.79	39.21
8	M	EE- 8/ 8	34.85	33.45	30.15	11.55	110.00	1.6379	62.09	37.91

****************************** ORDERED BY MAGNITUDE ******************************

NO.	SYMBOLS	CLASS	CHAN 1	CHAN 2	CHAN 3	CHAN 4	MAGNITUDE	VIS/IR	PCT.VIS	PCT.IR
8	M	EE- 8/ 8	34.85	33.45	30.15	11.55	110.00	1.6379	62.09	37.91
7	Y	EE- 7/ 8	40.97	42.87	39.12	14.96	137.91	1.5504	60.79	39.21
6	A	EE- 6/ 8	45.27	48.14	44.56	16.83	154.81	1.5214	60.34	39.66
5	O	EE- 5/ 8	48.38	51.80	47.28	18.25	165.71	1.5290	60.46	39.54
4	/	EE- 4/ 8	50.67	55.62	51.20	19.83	177.32	1.4964	59.94	40.06
3	=	EE- 3/ 8	53.52	59.34	54.41	20.97	188.25	1.4974	59.96	40.04
2	-	EE- 2/ 8	57.27	63.78	58.44	22.60	202.10	1.4937	59.90	40.10
1	.	EE- 1/ 8	60.17	69.48	63.96	24.87	218.48	1.4596	59.34	40.66

****************************** ORDERED BY RATIO ******************************

NO.	SYMBOLS	CLASS	CHAN 1	CHAN 2	CHAN 3	CHAN 4	MAGNITUDE	VIS/IR	PCT.VIS	PCT.IR
1	.	EE- 1/ 8	60.17	69.48	63.96	24.87	218.48	1.4596	59.34	40.66
2	-	EE- 2/ 8	57.27	63.78	58.44	22.60	202.10	1.4937	59.90	40.10
4	/	EE- 4/ 8	50.67	55.62	51.20	19.83	177.32	1.4964	59.94	40.06
3	=	EE- 3/ 8	53.52	59.34	54.41	20.97	188.25	1.4974	59.96	40.04
6	A	EE- 6/ 8	45.27	48.14	44.56	16.83	154.81	1.5214	60.34	39.66
5	O	EE- 5/ 8	48.38	51.80	47.28	18.25	165.71	1.5290	60.46	39.54
7	Y	EE- 7/ 8	40.97	42.87	39.12	14.96	137.91	1.5504	60.79	39.21
8	M	EE- 8/ 8	34.85	33.45	30.15	11.55	110.00	1.6379	62.09	37.91

******************** VARIANCES ********************

NO.	SYMBOLS	CLASS	CHAN 1	CHAN 2	CHAN 3	CHAN 4	NO. POINTS
1	.	EE- 1/ 8	3.84	3.90	7.96	3.49	46
2	-	EE- 2/ 8	3.53	3.45	4.71	2.83	93
3	=	EE- 3/ 8	3.19	2.66	2.35	2.20	61
4	/	EE- 4/ 8	5.14	2.65	2.81	2.29	69
5	O	EE- 5/ 8	3.40	1.29	2.70	2.41	65
6	A	EE- 6/ 8	2.80	3.06	3.94	2.30	78
7	Y	EE- 7/ 8	3.22	3.85	4.82	2.07	68
8	M	EE- 8/ 8	12.77	17.94	18.66	5.42	20

CLUSTERING OF 6% SAMPLE FOR TEST SITE 47

****************************** ORDERED BY CLASS ******************************

NO.	SYMBOLS	CLASS	CHAN 1	CHAN 2	CHAN 3	CHAN 4	MAGNITUDE	VIS/IR	PCT.VIS	PCT.IR
1	.	FF- 1/ 8	70.26	78.21	70.57	26.70	245.74	1.5262	60.42	39.58
2	-	FF- 2/ 8	66.58	72.17	64.75	25.00	228.49	1.5460	60.72	39.28
3	=	FF- 3/ 8	62.79	69.22	61.40	23.27	216.67	1.5592	60.93	39.07
4	/	FF- 4/ 8	61.56	64.80	59.78	22.89	209.03	1.5284	60.45	39.55
5	O	FF- 5/ 8	58.24	64.09	56.88	21.54	200.74	1.5600	60.94	39.06
6	A	FF- 6/ 8	56.36	60.26	53.30	20.14	190.06	1.5878	61.36	38.64
7	Y	FF- 7/ 8	51.13	54.74	48.33	17.80	172.00	1.6010	61.55	38.45
8	M	FF- 8/ 8	39.11	39.21	34.43	12.71	125.46	1.6614	62.43	37.57

****************************** ORDERED BY MAGNITUDE ******************************

NO.	SYMBOLS	CLASS	CHAN 1	CHAN 2	CHAN 3	CHAN 4	MAGNITUDE	VIS/IR	PCT.VIS	PCT.IR
8	M	FF- 8/ 8	39.11	39.21	34.43	12.71	125.46	1.6614	62.43	37.57
7	Y	FF- 7/ 8	51.13	54.74	48.33	17.80	172.00	1.6010	61.55	38.45
6	A	FF- 6/ 8	56.36	60.26	53.30	20.14	190.06	1.5878	61.36	38.64
5	O	FF- 5/ 8	58.24	64.09	56.88	21.54	200.74	1.5600	60.94	39.06
4	/	FF- 4/ 8	61.56	64.80	59.78	22.89	209.03	1.5284	60.45	39.55
3	=	FF- 3/ 8	62.79	69.22	61.40	23.27	216.67	1.5592	60.93	39.07
2	-	FF- 2/ 8	66.58	72.17	64.75	25.00	228.49	1.5460	60.72	39.28
1	.	FF- 1/ 8	70.26	78.21	70.57	26.70	245.74	1.5262	60.42	39.58

****************************** ORDERED BY RATIO ******************************

NO.	SYMBOLS	CLASS	CHAN 1	CHAN 2	CHAN 3	CHAN 4	MAGNITUDE	VIS/IR	PCT.VIS	PCT.IR
1	.	FF- 1/ 8	70.26	78.21	70.57	26.70	245.74	1.5262	60.42	39.58
4	/	FF- 4/ 8	61.56	64.80	59.78	22.89	209.03	1.5284	60.45	39.55
2	-	FF- 2/ 8	66.58	72.17	64.75	25.00	228.49	1.5460	60.72	39.28
3	=	FF- 3/ 8	62.79	69.22	61.40	23.27	216.67	1.5592	60.93	39.07
5	O	FF- 5/ 8	58.24	64.09	56.88	21.54	200.74	1.5600	60.94	39.06
6	A	FF- 6/ 8	56.36	60.26	53.30	20.14	190.06	1.5878	61.36	38.64
7	Y	FF- 7/ 8	51.13	54.74	48.33	17.80	172.00	1.6010	61.55	38.45
8	M	FF- 8/ 8	39.11	39.21	34.43	12.71	125.46	1.6614	62.43	37.57

******************** VARIANCES ********************

NO.	SYMBOLS	CLASS	CHAN 1	CHAN 2	CHAN 3	CHAN 4	NO. POINTS
1	.	FF- 1/ 8	3.50	3.35	7.90	3.65	47
2	-	FF- 2/ 8	4.39	3.97	4.33	2.52	59
3	=	FF- 3/ 8	2.56	1.56	3.29	2.20	98
4	/	FF- 4/ 8	2.66	2.48	3.79	2.19	64
5	O	FF- 5/ 8	2.26	3.04	3.00	2.25	80
6	A	FF- 6/ 8	2.47	3.47	2.76	1.57	70
7	Y	FF- 7/ 8	6.64	8.61	6.79	2.09	54
8	M	FF- 8/ 8	20.17	47.29	48.18	7.69	28

CLUSTERING OF 6% SAMPLE FOR TEST SITE 53

****************************** ORDERED BY CLASS ******************************

NO.	SYMBOLS	CLASS	CHAN 1	CHAN 2	CHAN 3	CHAN 4	MAGNITUDE	VIS/IR	PCT.VIS	PCT.IR
1	.	GG- 1/ 8	50.59	50.78	45.63	16.94	163.94	1.6202	61.83	38.17
2	-	GG- 2/ 8	46.32	47.26	43.20	16.12	152.91	1.5774	61.20	38.80
3	=	GG- 3/ 8	44.69	45.06	40.36	15.12	145.22	1.6177	61.80	38.20
4	/	GG- 4/ 8	41.94	43.12	39.53	14.89	139.48	1.5630	60.98	39.02
5	0	GG- 5/ 8	41.39	40.91	36.79	14.16	133.25	1.6151	61.76	38.24
6	A	GG- 6/ 8	38.09	37.61	33.88	12.86	122.43	1.6198	61.83	38.17
7	Y	GG- 7/ 8	35.15	33.15	29.96	10.74	109.00	1.6784	62.66	37.34
8	M	GG- 8/ 8	30.21	26.97	23.18	8.36	88.73	1.8127	64.45	35.55

****************************** ORDERED BY MAGNITUDE ******************************

NO.	SYMBOLS	CLASS	CHAN 1	CHAN 2	CHAN 3	CHAN 4	MAGNITUDE	VIS/IR	PCT.VIS	PCT.IR
8	M	GG- 8/ 8	30.21	26.97	23.18	8.36	88.73	1.8127	64.45	35.55
7	Y	GG- 7/ 8	35.15	33.15	29.96	10.74	109.00	1.6784	62.66	37.34
6	A	GG- 6/ 8	38.09	37.61	33.88	12.86	122.43	1.6198	61.83	38.17
5	0	GG- 5/ 8	41.39	40.91	36.79	14.16	133.25	1.6151	61.76	38.24
4	/	GG- 4/ 8	41.94	43.12	39.53	14.89	139.48	1.5630	60.98	39.02
3	=	GG- 3/ 8	44.69	45.06	40.36	15.12	145.22	1.6177	61.80	38.20
2	-	GG- 2/ 8	46.32	47.26	43.20	16.12	152.91	1.5774	61.20	38.80
1	.	GG- 1/ 8	50.59	50.78	45.63	16.94	163.94	1.6202	61.83	38.17

****************************** ORDERED BY RATIO ******************************

NO.	SYMBOLS	CLASS	CHAN 1	CHAN 2	CHAN 3	CHAN 4	MAGNITUDE	VIS/IR	PCT.VIS	PCT.IR
4	/	GG- 4/ 8	41.94	43.12	39.53	14.89	139.48	1.5630	60.98	39.02
2	-	GG- 2/ 8	46.32	47.26	43.20	16.12	152.91	1.5774	61.20	38.80
5	0	GG- 5/ 8	41.39	40.91	36.79	14.16	133.25	1.6151	61.76	38.24
3	=	GG- 3/ 8	44.69	45.06	40.36	15.12	145.22	1.6177	61.80	38.20
6	A	GG- 6/ 8	38.09	37.61	33.88	12.86	122.43	1.6198	61.83	38.17
1	.	GG- 1/ 8	50.59	50.78	45.63	16.94	163.94	1.6202	61.83	38.17
7	Y	GG- 7/ 8	35.15	33.15	29.96	10.74	109.00	1.6784	62.66	37.34
8	M	GG- 8/ 8	30.21	26.97	23.18	8.36	88.73	1.8127	64.45	35.55

******************** VARIANCES ********************

NO.	SYMBOLS	CLASS	CHAN 1	CHAN 2	CHAN 3	CHAN 4	NO. POINTS
1	.	GG- 1/ 8	2.05	3.29	3.88	1.94	51
2	-	GG- 2/ 8	1.54	2.19	2.52	1.45	74
3	=	GG- 3/ 8	1.66	1.33	1.94	1.46	90
4	/	GG- 4/ 8	1.20	1.79	2.42	1.29	83
5	0	GG- 5/ 8	2.06	2.02	1.90	1.08	67
6	A	GG- 6/ 8	1.47	1.04	3.67	1.22	56
7	Y	GG- 7/ 8	3.02	2.13	3.24	1.31	46
8	M	GG- 8/ 8	6.55	9.16	9.65	2.05	33

CLUSTERING OF 6% SAMPLE FOR TEST SITE 55

************************************ ORDERED BY CLASS ************************************

NO.	SYMBOLS	CLASS	CHAN 1	CHAN 2	CHAN 3	CHAN 4	MAGNITUDE	VIS/IR	PCT.VIS	PCT.IR
1	.	HH- 1/ 8	73.67	86.62	79.33	29.62	269.24	1.4712	59.53	40.47
2	-	HH- 2/ 8	63.55	70.99	64.46	24.56	223.57	1.5113	60.18	39.82
3	=	HH- 3/ 8	54.86	58.90	53.57	20.43	187.76	1.5373	60.59	39.41
4	/	HH- 4/ 8	50.59	52.34	45.90	16.93	165.76	1.6382	62.10	37.90
5	O	HH- 5/ 8	45.81	46.68	41.41	15.05	148.95	1.6383	62.10	37.90
6	A	HH- 6/ 8	41.69	41.23	36.14	13.29	132.35	1.6776	62.65	37.35
7	Y	HH- 7/ 8	36.32	35.23	31.08	11.67	114.29	1.6737	62.60	37.40
8	M	HH- 8/ 8	31.17	27.81	23.76	8.60	91.53	1.8118	64.44	35.56

************************************ ORDERED BY MAGNITUDE ************************************

NO.	SYMBOLS	CLASS	CHAN 1	CHAN 2	CHAN 3	CHAN 4	MAGNITUDE	VIS/IR	PCT.VIS	PCT.IR
8	M	HH- 8/ 8	31.17	27.81	23.96	8.60	91.53	1.8118	64.44	35.56
7	Y	HH- 7/ 8	36.32	35.23	31.08	11.67	114.29	1.6737	62.60	37.40
6	A	HH- 6/ 8	41.69	41.23	36.14	13.29	132.35	1.6776	62.65	37.35
5	O	HH- 5/ 8	45.81	46.68	41.41	15.05	148.95	1.6383	62.10	37.90
4	/	HH- 4/ 8	50.59	52.34	45.90	16.93	165.76	1.6382	62.10	37.90
3	=	HH- 3/ 8	54.86	58.90	53.57	20.43	187.76	1.5373	60.59	39.41
2	-	HH- 2/ 8	63.55	70.99	64.46	24.56	223.57	1.5113	60.18	39.82
1	.	HH- 1/ 8	73.67	86.62	79.33	29.62	269.24	1.4712	59.53	40.47

************************************ ORDERED BY RATIO ************************************

NO.	SYMBOLS	CLASS	CHAN 1	CHAN 2	CHAN 3	CHAN 4	MAGNITUDE	VIS/IR	PCT.VIS	PCT.IR
1	.	HH- 1/ 8	73.67	86.62	79.33	29.62	269.24	1.4712	59.53	40.47
2	-	HH- 2/ 8	63.55	70.99	64.46	24.56	223.57	1.5113	60.18	39.82
3	=	HH- 3/ 8	54.86	58.90	53.57	20.43	187.76	1.5373	60.59	39.41
4	/	HH- 4/ 8	50.59	52.34	45.90	16.93	165.76	1.6382	62.10	37.90
5	O	HH- 5/ 8	45.81	46.68	41.41	15.05	148.95	1.6383	62.10	37.90
7	Y	HH- 7/ 8	36.32	35.23	31.08	11.67	114.29	1.6737	62.60	37.40
6	A	HH- 6/ 8	41.69	41.23	36.14	13.29	132.35	1.6776	62.65	37.35
8	M	HH- 8/ 8	31.17	27.81	23.76	8.60	91.53	1.8118	64.44	35.56

************************ VARIANCES ************************

NO.	SYMBOLS	CLASS	CHAN 1	CHAN 2	CHAN 3	CHAN 4	NO. POINTS
1	.	HH- 1/ 8	17.33	55.45	37.13	11.95	21
2	-	HH- 2/ 8	6.97	10.39	8.78	3.52	121
3	=	HH- 3/ 8	4.63	6.57	12.66	6.36	21
4	/	HH- 4/ 8	3.45	3.38	3.99	2.02	41
5	O	HH- 5/ 8	3.41	2.58	3.30	1.31	79
6	A	HH- 6/ 8	3.82	3.87	2.79	0.90	91
7	Y	HH- 7/ 8	3.91	4.92	4.40	1.69	79
8	M	HH- 8/ 8	7.10	10.72	10.82	2.42	47

CLUSTERING OF 6% SAMPLE FOR TEST SITE 69

******************************** ORDERED BY CLASS ********************************

NO.	SYMBOLS	CLASS	CHAN 1	CHAN 2	CHAN 3	CHAN 4	MAGNITUDE	VIS/IR	PCT.VIS	PCT.IR
1	.	JJ- 1/ 8	72.54	81.92	74.94	28.31	257.71	1.4960	59.94	40.06
2	-	JJ- 2/ 8	70.87	78.05	67.74	26.58	245.24	1.5462	60.73	39.27
3	=	JJ- 3/ 8	67.52	73.39	67.75	25.21	233.87	1.5158	60.25	39.75
4	/	JJ- 4/ 8	65.92	71.15	63.57	25.02	225.65	1.5473	60.74	39.26
5	0	JJ- 5/ 8	62.85	68.12	60.92	23.09	214.98	1.5589	60.92	39.08
6	A	JJ- 6/ 8	59.36	64.34	57.45	21.80	202.95	1.5609	60.95	39.05
7	Y	JJ- 7/ 8	54.24	58.04	52.43	19.98	184.69	1.5505	60.79	39.21
8	M	JJ- 8/ 8	47.51	50.35	45.49	17.09	160.44	1.5637	60.79	39.01

******************************** ORDERED BY MAGNITUDE ********************************

NO.	SYMBOLS	CLASS	CHAN 1	CHAN 2	CHAN 3	CHAN 4	MAGNITUDE	VIS/IR	PCT.VIS	PCT.IR
8	M	JJ- 8/ 8	47.51	50.35	45.49	17.09	160.44	1.5637	60.99	39.01
7	Y	JJ- 7/ 8	54.24	58.04	52.43	19.78	184.69	1.5505	60.79	39.21
6	A	JJ- 6/ 8	59.36	64.34	57.45	21.80	202.95	1.5609	60.95	39.05
5	0	JJ- 5/ 8	62.35	68.12	60.92	23.09	214.98	1.5589	60.92	39.08
4	/	JJ- 4/ 8	65.92	71.15	63.57	25.02	225.65	1.5473	60.74	39.26
3	=	JJ- 3/ 8	67.52	73.39	67.75	25.21	233.37	1.5158	60.25	39.75
2	-	JJ- 2/ 8	70.87	78.05	69.74	26.58	245.24	1.5462	60.73	39.27
1	.	JJ- 1/ 8	72.54	81.92	74.94	28.31	257.71	1.4960	59.74	40.06

******************************** ORDERED BY RATIO ********************************

NO.	SYMBOLS	CLASS	CHAN 1	CHAN 2	CHAN 3	CHAN 4	MAGNITUDE	VIS/IR	PCT.VIS	PCT.IR
1	.	JJ- 1/ 8	72.54	81.92	74.94	28.31	257.71	1.4960	59.94	40.06
3	=	JJ- 3/ 8	67.52	73.39	67.75	25.21	233.87	1.5158	60.25	39.75
2	-	JJ- 2/ 8	70.87	78.05	69.74	26.58	245.24	1.5462	60.73	39.27
4	/	JJ- 4/ 8	65.72	71.15	63.57	25.02	225.65	1.5473	60.74	39.26
7	Y	JJ- 7/ 8	54.24	58.04	52.43	19.98	184.69	1.5505	60.79	39.21
5	0	JJ- 5/ 8	62.85	68.12	60.92	23.09	214.98	1.5589	60.92	39.08
6	A	JJ- 6/ 8	59.36	64.34	57.45	21.80	202.95	1.5609	60.95	39.05
8	M	JJ- 8/ 8	47.51	50.35	45.49	17.09	160.44	1.5637	60.99	39.01

******************** VARIANCES ********************

NO.	SYMBOLS	CLASS	CHAN 1	CHAN 2	CHAN 3	CHAN 4	NO. POINTS
1	.	JJ- 1/ 8	3.52	4.81	7.01	3.74	72
2	-	JJ- 2/ 8	2.81	2.21	4.46	2.41	76
3	=	JJ- 3/ 8	3.42	3.04	2.95	2.43	56
4	/	JJ- 4/ 8	3.23	1.76	1.44	2.12	60
5	0	JJ- 5/ 8	1.85	2.66	2.50	2.27	66
6	A	JJ- 6/ 8	3.33	2.31	3.96	2.00	76
7	Y	JJ- 7/ 8	3.54	4.76	5.65	2.10	51
8	M	JJ- 8/ 8	9.02	10.66	7.83	2.23	43

CLUSTERING OF 6% SAMPLE FOR TEST SITE 07

******************************** ORDERED BY CLASS ********************************

NO.	SYMBOLS	CLASS	CHAN 1	CHAN 2	CHAN 3	CHAN 4	MAGNITUDE	VIS/IR	PCT.VIS	PCT.IR
1	.	KK- 1/ 8	64.36	80.87	75.17	28.51	248.91	1.4007	58.35	41.65
2	-	KK- 2/ 8	63.08	77.50	70.74	26.59	238.11	1.4414	59.04	40.96
3	=	KK- 3/ 8	62.89	73.49	69.22	26.58	232.18	1.4236	58.74	41.26
4	/	KK- 4/ 8	60.72	73.37	66.15	26.27	226.71	1.4530	59.23	40.77
5	O	KK- 5/ 8	61.49	70.69	64.03	24.66	220.86	1.4903	59.84	40.16
6	A	KK- 6/ 8	58.71	67.51	61.37	23.51	211.10	1.4871	59.79	40.21
7	Y	KK- 7/ 8	57.10	63.48	57.24	21.62	199.44	1.5290	60.46	39.54
8	M	KK- 8/ 8	53.40	57.02	51.38	19.05	180.85	1.5680	61.06	38.94

******************************** ORDERED BY MAGNITUDE ********************************

NO.	SYMBOLS	CLASS	CHAN 1	CHAN 2	CHAN 3	CHAN 4	MAGNITUDE	VIS/IR	PCT.VIS	PCT.IR
8	M	KK- 8/ 8	53.40	57.02	51.38	19.05	180.85	1.5680	61.06	38.94
7	Y	KK- 7/ 8	57.10	63.48	57.24	21.62	199.44	1.5290	60.46	39.54
6	A	KK- 6/ 8	58.71	67.51	61.37	23.51	211.10	1.4871	59.79	40.21
5	O	KK- 5/ 8	61.49	70.69	64.03	24.66	220.86	1.4903	59.84	40.16
4	/	KK- 4/ 8	60.92	73.37	66.15	26.27	226.71	1.4530	59.23	40.77
3	=	KK- 3/ 8	62.89	73.49	69.22	26.58	232.18	1.4236	58.74	41.26
2	-	KK- 2/ 8	63.08	77.50	70.94	26.59	238.11	1.4414	59.04	40.96
1	.	KK- 1/ 8	64.36	80.87	75.17	28.51	248.71	1.4007	58.35	41.65

******************************** ORDERED BY RATIO ********************************

NO.	SYMBOLS	CLASS	CHAN 1	CHAN 2	CHAN 3	CHAN 4	MAGNITUDE	VIS/IR	PCT.VIS	PCT.IR
1	.	KK- 1/ 8	64.36	80.87	75.17	28.51	248.91	1.4007	58.35	41.65
3	=	KK- 3/ 8	62.89	73.49	69.22	26.58	232.18	1.4236	58.74	41.26
2	-	KK- 2/ 8	63.08	77.50	70.94	26.59	238.11	1.4414	59.04	40.96
4	/	KK- 4/ 8	60.92	73.37	66.15	26.27	226.71	1.4530	59.23	40.77
6	A	KK- 6/ 8	58.71	67.51	61.37	23.51	211.10	1.4871	59.79	40.21
5	O	KK- 5/ 8	61.49	70.69	64.03	24.66	220.86	1.4903	59.84	40.16
7	Y	KK- 7/ 8	57.10	63.48	57.24	21.62	199.44	1.5290	60.46	39.54
8	M	KK- 8/ 8	53.40	57.02	51.38	19.05	180.85	1.5680	61.06	38.94

******************** VARIANCES ********************

NO.	SYMBOLS	CLASS	CHAN 1	CHAN 2	CHAN 3	CHAN 4	NO. POINTS
1	.	KK- 1/ 8	3.70	3.85	4.72	3.75	53
2	-	KK- 2/ 8	2.63	1.92	3.11	2.82	102
3	=	KK- 3/ 8	2.50	2.37	2.36	3.23	76
4	/	KK- 4/ 8	1.92	2.67	1.74	2.28	52
5	O	KK- 5/ 8	2.67	1.87	3.21	2.17	35
6	A	KK- 6/ 8	3.00	2.17	2.11	2.26	49
7	Y	KK- 7/ 8	2.59	3.47	3.68	2.17	93
8	M	KK- 8/ 8	6.81	11.31	7.73	3.07	40

CLUSTERING OF 6% SAMPLE FOR TEST SITE 88

****************************** ORDERED BY CLASS ******************************

NO.	SYMBOLS	CLASS	CHAN 1	CHAN 2	CHAN 3	CHAN 4	MAGNITUDE	VIS/IR	PCT.VIS	PCT.IR
1	.	LL- 1/ 8	69.56	88.31	83.13	32.50	273.50	1.3654	57.72	42.28
2	-	LL- 2/ 8	64.06	79.54	73.75	28.66	246.00	1.4023	58.37	41.63
3	=	LL- 3/ 8	63.23	76.84	71.84	26.03	237.94	1.4312	58.87	41.13
4	/	LL- 4/ 8	64.00	76.71	67.92	26.62	235.25	1.4883	59.81	40.19
5	0	LL- 5/ 8	60.87	73.19	69.83	27.07	230.76	1.3834	58.04	41.96
6	A	LL- 6/ 8	62.69	71.92	67.56	25.01	227.19	1.4541	59.25	40.75
7	Y	LL- 7/ 8	59.61	70.96	64.89	25.67	221.13	1.4419	59.05	40.95
8	M	LL- 8/ 8	54.62	64.15	60.62	23.54	202.92	1.4113	58.53	41.47

****************************** ORDERED BY MAGNITUDE ******************************

NO.	SYMBOLS	CLASS	CHAN 1	CHAN 2	CHAN 3	CHAN 4	MAGNITUDE	VIS/IR	PCT.VIS	PCT.IR
8	M	LL- 8/ 8	54.62	64.15	60.62	23.54	202.92	1.4113	58.53	41.47
7	Y	LL- 7/ 8	59.61	70.96	64.89	25.67	221.13	1.4419	59.05	40.95
6	A	LL- 6/ 8	62.69	71.92	67.56	25.01	227.19	1.4541	59.25	40.75
5	0	LL- 5/ 8	60.87	73.19	69.83	27.07	230.76	1.3834	58.04	41.96
4	/	LL- 4/ 8	64.00	76.71	67.92	26.62	235.25	1.4883	59.81	40.19
3	=	LL- 3/ 8	63.23	76.84	71.84	26.03	237.94	1.4312	58.87	41.13
2	-	LL- 2/ 8	64.06	79.54	73.75	28.66	246.00	1.4023	58.37	41.63
1	.	LL- 1/ 8	69.56	88.31	83.13	32.50	273.50	1.3654	57.72	42.28

****************************** ORDERED BY RATIO ******************************

NO.	SYMBOLS	CLASS	CHAN 1	CHAN 2	CHAN 3	CHAN 4	MAGNITUDE	VIS/IR	PCT.VIS	PCT.IR
1	.	LL- 1/ 8	69.56	88.31	83.13	32.50	273.50	1.3654	57.72	42.28
5	0	LL- 5/ 8	60.87	73.19	69.83	27.07	230.76	1.3834	58.04	41.96
2	-	LL- 2/ 8	64.06	79.54	73.75	28.66	246.00	1.4023	58.37	41.63
8	M	LL- 8/ 8	54.62	64.15	60.62	23.54	202.92	1.4113	58.53	41.47
3	=	LL- 3/ 8	63.23	76.84	71.84	26.03	237.94	1.4312	58.87	41.13
7	Y	LL- 7/ 8	59.61	70.96	64.89	25.67	221.13	1.4419	59.05	40.75
6	A	LL- 6/ 8	62.69	71.92	67.56	25.01	227.19	1.4541	59.25	40.75
4	/	LL- 4/ 8	64.00	76.71	67.92	26.62	235.25	1.4083	59.81	40.19

******************** VARIANCES ********************

NO.	SYMBOLS	CLASS	CHAN 1	CHAN 2	CHAN 3	CHAN 4	NO. POINTS
1	.	LL- 1/ 8	4.93	13.56	10.78	3.07	16
2	-	LL- 2/ 8	2.57	2.71	5.62	2.71	67
3	=	LL- 3/ 8	2.83	1.81	1.58	1.59	69
4	/	LL- 4/ 8	2.44	1.49	1.83	2.68	92
5	0	LL- 5/ 8	3.13	1.99	3.01	2.62	84
6	A	LL- 6/ 8	2.80	1.24	2.40	0.82	80
7	Y	LL- 7/ 8	3.24	2.55	3.05	3.59	79
8	M	LL- 8/ 8	11.42	12.14	5.59	3.10	13

CLUSTERING OF 6% SAMPLE FOR TEST SITE 71

****************************** ORDERED BY CLASS ******************************

NO.	SYMBOLS	CLASS	CHAN 1	CHAN 2	CHAN 3	CHAN 4	MAGNITUDE	VIS/IR	PCT.VIS	PCT.IR
1	.	MM- 1/ 8	67.37	76.89	69.53	26.58	240.37	1.5011	60.02	39.98
2	-	MM- 2/ 8	65.73	73.02	66.40	25.59	230.74	1.5083	60.13	39.87
3	=	MM- 3/ 8	64.36	71.76	63.11	24.83	224.06	1.5478	60.75	39.25
4	/	MM- 4/ 8	63.54	69.20	64.50	23.41	220.65	1.5100	60.16	39.84
5	O	MM- 5/ 8	63.61	68.32	60.47	23.42	215.82	1.5726	61.13	38.87
6	A	MM- 6/ 8	59.85	66.57	59.90	22.78	209.10	1.5289	60.46	39.54
7	Y	MM- 7/ 8	58.68	63.64	56.84	21.69	200.84	1.5576	60.90	39.10
8	M	MM- 8/ 8	55.88	59.25	52.65	19.67	187.45	1.5918	61.42	38.58

****************************** ORDERED BY MAGNITUDE ******************************

NO.	SYMBOLS	CLASS	CHAN 1	CHAN 2	CHAN 3	CHAN 4	MAGNITUDE	VIS/IR	PCT.VIS	PCT.IR
8	M	MM- 8/ 8	55.88	59.25	52.65	19.67	187.45	1.5918	61.42	38.58
7	Y	MM- 7/ 8	58.68	63.64	56.84	21.69	200.84	1.5576	60.90	39.10
6	A	MM- 6/ 8	59.85	66.57	59.90	22.78	209.10	1.5289	60.46	39.54
5	O	MM- 5/ 8	63.61	68.32	60.47	23.42	215.82	1.5726	61.13	38.87
4	/	MM- 4/ 8	63.54	69.20	64.50	23.41	220.65	1.5100	60.16	39.84
3	=	MM- 3/ 8	64.36	71.76	63.11	24.83	224.06	1.5478	60.75	39.25
2	-	MM- 2/ 8	65.73	73.02	66.40	25.59	230.74	1.5083	60.13	39.87
1	.	MM- 1/ 8	67.37	76.89	69.53	26.58	240.37	1.5011	60.02	39.98

****************************** ORDERED BY RATIO ******************************

NO.	SYMBOLS	CLASS	CHAN 1	CHAN 2	CHAN 3	CHAN 4	MAGNITUDE	VIS/IR	PCT.VIS	PCT.IR
1	.	MM- 1/ 8	67.37	76.89	69.53	26.58	240.37	1.5011	60.02	39.98
2	-	MM- 2/ 8	65.73	73.02	66.40	25.59	230.74	1.5083	60.13	39.87
4	/	MM- 4/ 8	63.54	69.20	64.50	23.41	220.65	1.5100	60.16	39.84
6	A	MM- 6/ 8	59.85	66.57	59.90	22.78	209.10	1.5289	60.46	39.54
3	=	MM- 3/ 8	64.36	71.76	63.11	24.83	224.06	1.5478	60.75	39.25
7	Y	MM- 7/ 8	58.68	63.64	56.84	21.69	200.84	1.5576	60.90	39.10
5	O	MM- 5/ 8	63.61	68.32	60.47	23.42	215.82	1.5726	61.13	38.87
8	M	MM- 8/ 8	55.88	59.25	52.65	19.67	187.45	1.5918	61.42	38.58

******************** VARIANCES ********************

NO.	SYMBOLS	CLASS	CHAN 1	CHAN 2	CHAN 3	CHAN 4	NO. POINTS
1	.	MM- 1/ 8	3.17	3.28	4.29	2.93	57
2	-	MM- 2/ 8	3.33	1.38	2.36	2.68	88
3	=	MM- 3/ 8	1.65	0.91	1.61	1.85	70
4	/	MM- 4/ 8	2.93	1.00	1.42	1.00	54
5	O	MM- 5/ 8	1.35	2.47	1.50	2.28	57
6	A	MM- 6/ 8	2.03	2.35	1.75	1.70	60
7	Y	MM- 7/ 8	3.57	2.67	3.07	1.92	74
8	M	MM- 8/ 8	4.47	5.06	4.44	2.02	40

CLUSTERING OF 6% SAMPLE FOR TEST SITE 94

****************************** ORDERED BY CLASS ******************************

NO.	SYMBOLS	CLASS	CHAN 1	CHAN 2	CHAN 3	CHAN 4	MAGNITUDE	VIS/IR	PCT.VIS	PCT.IR
1	.	NN- 1/ 8	52.81	58.92	54.44	22.42	188.58	1.4536	59.24	40.76
2	-	NN- 2/ 8	48.83	53.20	49.55	19.60	171.17	1.4755	59.60	40.40
3	=	NN- 3/ 8	45.91	49.79	45.91	18.12	159.72	1.4947	59.91	40.09
4	/	NN- 4/ 8	43.77	46.91	43.53	17.09	151.30	1.4959	59.93	40.07
5	O	NN- 5/ 8	42.07	43.56	40.71	16.03	142.37	1.5090	60.14	39.86
6	A	NN- 6/ 8	39.11	39.81	37.47	14.65	131.04	1.5140	60.22	39.78
7	Y	NN- 7/ 8	36.29	36.05	32.63	12.77	117.74	1.5933	61.44	38.56
8	M	NN- 8/ 8	31.88	29.74	27.03	10.62	99.26	1.6367	62.07	37.93

****************************** ORDERED BY MAGNITUDE ******************************

NO.	SYMBOLS	CLASS	CHAN 1	CHAN 2	CHAN 3	CHAN 4	MAGNITUDE	VIS/IR	PCT.VIS	PCT.IR
8	M	NN- 8/ 8	31.88	29.74	27.03	10.62	99.26	1.6367	62.07	37.93
7	Y	NN- 7/ 8	36.29	36.05	32.63	12.77	117.74	1.5933	61.44	38.56
6	A	NN- 6/ 8	39.11	39.81	37.47	14.65	131.04	1.5140	60.22	39.78
5	O	NN- 5/ 8	42.07	43.56	40.71	16.03	142.37	1.5090	60.14	39.86
4	/	NN- 4/ 8	43.77	46.91	43.53	17.09	151.30	1.4959	59.93	40.07
3	=	NN- 3/ 8	45.91	49.79	45.91	18.12	159.72	1.4947	59.91	40.09
2	-	NN- 2/ 8	48.83	53.20	49.55	19.60	171.17	1.4755	59.60	40.40
1	.	NN- 1/ 8	52.81	58.92	54.44	22.42	188.58	1.4536	59.24	40.76

****************************** ORDERED BY RATIO ******************************

NO.	SYMBOLS	CLASS	CHAN 1	CHAN 2	CHAN 3	CHAN 4	MAGNITUDE	VIS/IR	PCT.VIS	PCT.IR
1	.	NN- 1/ 8	52.81	58.92	54.44	22.42	188.58	1.4536	59.24	40.76
2	-	NN- 2/ 8	48.83	53.20	49.55	19.60	171.17	1.4755	59.60	40.40
3	=	NN- 3/ 8	45.91	49.79	45.91	18.12	159.72	1.4947	59.91	40.09
4	/	NN- 4/ 8	43.77	46.91	43.53	17.09	151.30	1.4959	59.93	40.07
5	O	NN- 5/ 8	42.07	43.56	40.71	16.03	142.37	1.5090	60.14	39.86
6	A	NN- 6/ 8	39.11	39.81	37.47	14.65	131.04	1.5140	60.22	39.78
7	Y	NN- 7/ 8	36.29	36.05	32.63	12.77	117.74	1.5933	61.44	38.56
8	M	NN- 8/ 8	31.88	29.74	27.03	10.62	99.26	1.6367	62.07	37.93

******************** VARIANCES ********************

NO.	SYMBOLS	CLASS	CHAN 1	CHAN 2	CHAN 3	CHAN 4	NO. POINTS
1	.	NN- 1/ 8	7.76	10.71	11.46	2.88	36
2	-	NN- 2/ 8	2.81	2.73	2.82	1.50	82
3	=	NN- 3/ 8	1.85	2.63	1.58	1.60	76
4	/	NN- 4/ 8	2.08	1.83	2.15	1.54	79
5	O	NN- 5/ 8	1.72	1.70	1.93	1.55	59
6	A	NN- 6/ 8	1.90	1.96	2.06	1.53	72
7	Y	NN- 7/ 8	2.70	3.46	2.47	1.46	62
8	M	NN- 8/ 8	3.20	5.84	6.45	1.82	34

CLUSTERING OF 6% SAMPLE FOR TEST SITE 95

****************************** ORDERED BY CLASS ******************************

NO.	SYMBOLS	CLASS	CHAN 1	CHAN 2	CHAN 3	CHAN 4	MAGNITUDE	VIS/IR	PCT.VIS	PCT.IR
1	.	PP- 1/ 8	52.36	58.69	54.61	22.03	187.69	1.4491	59.17	40.83
2	-	PP- 2/ 8	48.76	52.98	49.30	19.65	170.70	1.4755	59.60	40.40
3	=	PP- 3/ 8	45.43	49.04	45.54	18.15	158.15	1.4832	59.73	40.27
4	/	PP- 4/ 8	43.66	46.17	42.49	16.80	149.12	1.5152	60.24	39.76
5	0	PP- 5/ 8	41.71	43.66	40.10	15.41	140.88	1.5376	60.59	39.41
6	A	PP- 6/ 8	40.07	39.86	37.61	14.59	132.14	1.5312	60.49	39.51
7	Y	PP- 7/ 8	37.43	36.78	33.59	12.97	120.78	1.5937	61.44	38.56
8	M	PP- 8/ 8	33.34	30.47	27.94	10.47	102.21	1.6615	62.43	37.57

****************************** ORDERED BY MAGNITUDE ******************************

NO.	SYMBOLS	CLASS	CHAN 1	CHAN 2	CHAN 3	CHAN 4	MAGNITUDE	VIS/IR	PCT.VIS	PCT.IR
8	M	PP- 8/ 8	33.34	30.47	27.94	10.47	102.21	1.6615	62.43	37.57
7	Y	PP- 7/ 8	37.43	36.78	33.59	12.97	120.78	1.5937	61.44	38.56
6	A	PP- 6/ 8	40.07	39.86	37.61	14.59	132.14	1.5312	60.49	39.51
5	0	PP- 5/ 8	41.71	43.66	40.10	15.41	140.88	1.5376	60.59	39.41
4	/	PP- 4/ 8	43.66	46.17	42.49	16.80	149.12	1.5152	60.24	39.76
3	=	PP- 3/ 8	45.43	49.04	45.54	18.15	158.15	1.4832	59.73	40.27
2	-	PP- 2/ 8	48.76	52.98	49.30	19.65	170.70	1.4755	59.60	40.40
1	.	PP- 1/ 8	52.36	58.69	54.61	22.03	187.69	1.4491	59.17	40.83

****************************** ORDERED BY RATIO ******************************

NO.	SYMBOLS	CLASS	CHAN 1	CHAN 2	CHAN 3	CHAN 4	MAGNITUDE	VIS/IR	PCT.VIS	PCT.IR
1	.	PP- 1/ 8	52.36	58.69	54.61	22.03	187.69	1.4491	59.17	40.83
2	-	PP- 2/ 8	48.76	52.98	49.30	19.65	170.70	1.4755	59.60	40.40
3	=	PP- 3/ 8	45.43	49.04	45.54	18.15	158.15	1.4832	59.73	40.27
4	/	PP- 4/ 8	43.66	46.17	42.49	16.80	149.12	1.5152	60.24	39.76
6	A	PP- 6/ 8	40.07	39.86	37.61	14.59	132.14	1.5312	60.49	39.51
5	0	PP- 5/ 8	41.71	43.66	40.10	15.41	140.88	1.5376	60.59	39.41
7	Y	PP- 7/ 8	37.43	36.78	33.59	12.97	120.78	1.5937	61.44	38.56
8	M	PP- 8/ 8	33.34	30.47	27.94	10.47	102.21	1.6615	62.43	37.57

******************** VARIANCES ********************

NO.	SYMBOLS	CLASS	CHAN 1	CHAN 2	CHAN 3	CHAN 4	NO. POINTS
1	.	PP- 1/ 8	5.15	6.73	6.36	2.49	36
2	-	PP- 2/ 8	2.68	3.18	2.18	1.65	66
3	=	PP- 3/ 8	1.91	2.81	2.01	1.55	34
4	/	PP- 4/ 8	1.88	1.97	2.15	1.03	59
5	0	PP- 5/ 8	1.23	1.84	2.41	1.09	58
6	A	PP- 6/ 8	2.15	2.04	1.37	1.20	74
7	Y	PP- 7/ 8	1.58	3.08	3.55	1.28	76
8	M	PP- 8/ 8	4.97	4.04	5.45	1.43	47

CLUSTERING OF 6% SAMPLE FOR TEST SITE 103

******************************** ORDERED BY CLASS ********************************

NO.	SYMBOLS	CLASS	CHAN 1	CHAN 2	CHAN 3	CHAN 4	MAGNITUDE	VIS/IR	PCT.VIS	PCT.IR
1	.	RR- 1/ 8	61.78	68.44	62.33	24.00	216.56	1.5084	60.13	39.87
2	-	RR- 2/ 8	58.07	63.24	57.43	21.75	200.49	1.5319	60.50	39.50
3	=	RR- 3/ 8	55.27	59.78	54.12	20.27	189.44	1.5467	60.73	39.27
4	/	RR- 4/ 8	53.11	57.25	51.31	19.54	181.21	1.5576	60.70	39.10
5	0	RR- 5/ 8	52.30	54.46	48.87	18.35	173.98	1.5882	61.36	38.64
6	A	RR- 6/ 8	49.08	52.65	47.28	17.79	166.81	1.5632	60.79	39.01
7	Y	RR- 7/ 8	47.13	49.77	44.65	16.49	158.05	1.5848	61.31	38.69
8	M	RR- 8/ 8	44.35	46.19	42.09	15.58	148.21	1.5678	61.09	38.91

******************************** ORDERED BY MAGNITUDE ********************************

NO.	SYMBOLS	CLASS	CHAN 1	CHAN 2	CHAN 3	CHAN 4	MAGNITUDE	VIS/IR	PCT.VIS	PCT.IR
8	M	RR- 8/ 8	44.35	46.19	42.09	15.58	148.21	1.5698	61.09	38.91
7	Y	RR- 7/ 8	47.13	49.77	44.65	16.49	158.05	1.5848	61.31	38.69
6	A	RR- 6/ 8	49.08	52.65	47.28	17.79	166.81	1.5632	60.99	39.01
5	0	RR- 5/ 8	52.30	54.46	48.87	18.35	173.98	1.5882	61.36	38.64
4	/	RR- 4/ 8	53.11	57.25	51.31	19.54	181.21	1.5576	60.90	39.10
3	=	RR- 3/ 8	55.27	59.78	54.12	20.27	189.44	1.5467	60.73	39.27
2	-	RR- 2/ 8	58.07	63.24	57.43	21.75	200.49	1.5319	60.50	39.50
1	.	RR- 1/ 8	61.78	68.44	62.33	24.00	216.56	1.5084	60.13	39.37

******************************** ORDERED BY RATIO ********************************

NO.	SYMBOLS	CLASS	CHAN 1	CHAN 2	CHAN 3	CHAN 4	MAGNITUDE	VIS/IR	PCT.VIS	PCT.IR
1	.	RR- 1/ 8	61.78	68.44	62.33	24.00	216.56	1.5084	60.13	39.87
2	-	RR- 2/ 8	58.07	63.24	57.43	21.75	200.49	1.5319	60.50	39.50
3	=	RR- 3/ 8	55.27	59.78	54.12	20.27	189.44	1.5467	60.73	39.27
4	/	RR- 4/ 8	53.11	57.25	51.31	19.54	181.21	1.5576	60.70	39.10
6	A	RR- 6/ 8	49.08	52.65	47.28	17.79	166.81	1.5632	60.99	39.01
8	M	RR- 8/ 8	44.35	46.19	42.09	15.58	148.21	1.5698	61.09	38.71
7	Y	RR- 7/ 8	47.13	49.77	44.65	16.49	158.05	1.5848	61.31	38.69
5	0	RR- 5/ 8	52.30	54.46	48.87	18.35	173.98	1.5882	61.36	38.64

******************** VARIANCES ********************

NO.	SYMBOLS	CLASS	CHAN 1	CHAN 2	CHAN 3	CHAN 4	NO. POINTS
1	.	RR- 1/ 8	2.49	6.33	7.85	3.92	27
2	-	RR- 2/ 8	3.16	2.90	3.26	2.11	76
3	=	RR- 3/ 8	1.42	2.30	1.64	1.89	78
4	/	RR- 4/ 8	2.17	1.92	1.55	1.39	61
5	0	RR- 5/ 8	1.23	2.29	1.59	1.21	54
6	A	RR- 6/ 8	1.32	1.01	2.05	1.18	78
7	Y	RR- 7/ 8	1.80	2.08	1.33	1.13	83
8	M	RR- 8/ 8	2.90	3.78	4.14	1.06	43